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THE NATIONAL GEOGRAPHIC MAGAZINE

Flying in the "Blowtorch" Era

By FREDERICK G. VOSBURGH

Since the days of man-lifting kites and crude flying machines called "aerodromes," the NATIONAL GEOGRAPHIC MAGAZINE *has published through the years 110 articles on aeronautics. To give its members a clear understanding of this age of phenomenal speeds resulting from jet and rocket propulsion, the National Geographic Society has assembled facts and photographs, primarily in the United States, for presentation in the following article, which has been approved by official sources. The author traveled by air throughout the country to make this firsthand survey.*—The Editor.

FIVE HUNDRED miles an hour, said the air-speed indicator. As our jet plane smoothly gathered momentum, the hand moved up to 510, to 520.

In a mere training plane we were traveling nearly a hundred miles an hour faster than any American fighting aircraft flew in action in World War II.

As the Lockheed T-33 shot through the sunny sky a mile above Eglin Air Force Base, Florida, I felt no sensation of terrific speed. With nothing but wispy white clouds in sight, 520 seemed no faster than I had flown in commercial airliners or in Black Widow night fighters during the war.

"No telephone poles up here to whiz past," said Capt. Don Lopez from the pilot's seat through the throat mike that picked up his voice from his Adam's apple. "If there were, they'd look like teeth in a comb."

Even at 520 miles an hour the turbojet engine behind us drove the two-seater with no vibration and with little noise I could hear above the scream of the outraged air. I could scribble notes as legibly as in a Pullman. The only tremble came when I glanced at that telltale air-speed hand.

"Want to see how she rolls?" came the pilot's voice through the earphones as we slowed down to 300.

"Sure," I gulped.

The duplicate control stick before me moved to the left, and the earth changed places with the sky twice while the hurtling plane stayed steady as a rock. Throttled back, we glided down to a smooth tricycle landing.

Now I knew what a jet jockey meant when he said, "It's like riding in a 1950 Cadillac after a Model T."

Fastest Planes Keep Pace with Sun

On a 7,000-mile swing around the United States I was seeing the revolution taking place in aviation. Jet and rocket engines have given flying literally "a blowtorch in the tail," as today's pilots refer to the fierce, hot blast of their jets.

Though I saw no flying saucers, new sky craft seemed almost as strange to this old Air Force relic of the days when our fighting planes were pulled by fans. Most of them now are blistered along by a stream of hot gas.

In this era of rocket and jet propulsion, speed of flight has so increased that flyers in today's fastest planes could briefly perform Joshua's miracle of making the sun stand still.

Pilots sealed inside the Bell X-1 rocket ships have flown so fast over California's Mojave Desert that if they were headed west the sun above them would appear not to move—in fact, it might go backward. In their two-and-a-half minutes of full power they can reach or even exceed the rate the world goes round at that latitude—852 miles an hour.

Now with retirement of the X-1 *Glamorous Glennis* to the Smithsonian Institution, her

Plane Builders Compete in Designing Jet Fighters; Here Are Two of the Newest

Built as rivals in an Air Force design competition were McDonnell's XF-88 Voodoo (lower), North American's YF-93A (upper), and Lockheed's XF-90 (page 290). "May the best plane win," said the Air Force in effect, after specifying speed, range, altitude, and other requirements. All are big, heavy fighters, with swept-back wings. Unlike its twin-jet competitors, North American's entry packs its power in a single jet engine. All three have the emergency extra-power device known as an "afterburner" (pages 289 and 310).

place is to be taken by the Bell X-1A built to go 1,700 miles an hour in 4.2 minutes of rocket blast. Up and up goes the curve of speed, faster since the war than ever before.

Less than three years have passed since Air Force Capt. Charles E. ("Chuck") Yeager, in the *Glamorous Glennis* named for his attractive wife, became the first man in the world to fly faster than sound travels—about 660 to 760 miles an hour, depending on temperature (page 302). During that time X-1 planes and the Navy's Douglas-built Skyrocket have surpassed the speed of sound again and again, at altitudes ranging from several miles in the air to within 50 feet of the ground.

When flying low, "on the deck," the jet- and rocket-driven Skyrocket, with incredibly tiny backswept wings, approaches as silently as a big white fish, which it faintly resembles. Its mighty roar, outstripped by the source, trails behind and is heard after the plane has passed.

Such planes are packed with instruments, from "swordfish" test boom (page 309) to tail. Guidance they give designers helps shape the future in the air.

Stratojet's Thin Wings "Wave at You"

Among the latest to be tested against Father Time and the laws of aerodynamics is the new Air Force delta-winged plane built by Consolidated Vultee. Its wings are triangles and it has no tail, just a fin on the back of the fuselage (page 315).

Tailless, too, is the Navy's rakish new Chance Vought Cutlass carrier fighter (page 289). Remarked an Air Force officer, "It

A New Fighter Tries Oddly Shaped Wings; Another Dumps Fuel from Wing-tip Tanks

Most wings taper toward the ends, but those of Republic's XF-91 (top), experimental high-altitude Air Force interceptor-fighter, are widest and thickest at the tips. They slant sharply backward and can be turned up or down in flight to increase or lessen their lift (pages 287-8). That stout tail is designed to hold both jet and rocket engines; top speed is a military secret. Over Long Island, a Navy carrier-borne jet fighter, the Grumman F9F Panther, shows how it jettisons fuel instead of dropping costly wingtip tanks before combat.

looks as if it's going about 800 miles an hour just sitting on the ground."

Flexible swept-back wings of Boeing's B-47 Stratojet bomber are so thin that they droop when the plane is at rest. They bend the other way when they carry the weight of the six-jet bomber, as big as a Superfortress (page 294). In flight they flex like a fly rod, as much as seven feet at the tips.

"You sit there and watch 'em wave at you," grinned Bob Robbins, former B-47 project pilot and now an assistant project engineer. "They take up a lot of the shock and give you a nice smooth ride in rough air."

Much of the necessary strength is in the aluminum alloy "skin," up to five-eighths of an inch thick.

This newest operational Air Force bomber is a good example of how the contributions of many men make a modern plane. Experimental models wore out brakes and tires, so "hot" was the plane in landing.

"Look, why don't you use a chute to slow her down?" drawled an Air Force test pilot, Maj. Guy M. Townsend. "We used to toss out our chutes during the war when our brakes were shot out, and it worked fine."

The result was the parachute brake, now standard on the Stratojet (page 308).

Little Herbert Joins the Crew

Another result of flight tests was "Little Herbert," who got his start in a junk yard.

Test-flying the Stratojet at Larson Air Force Base, Moses Lake, Washington, pilots found that it sometimes had a "Dutch roll," swinging one way, then the other, like a waltzer on skates.

Planes Spawn Artillery: Howitzers with Parachutes Tumble from Fairchild C-82's in a Demonstration for President Truman

Jeeps that pull the 105-mm. howitzers were dropped a few seconds later from the big propeller-driven transports with their sawed-off-seeming bodies. Each cannon weighs 4,900 pounds, each jeep 2,660. Ninth Air Force troop carriers and the Army's 82d Airborne Division put on this show at Fort Bragg, North Carolina.

A "Light Bomber" in Today's Air Force, the B-45 Tornado Far Outweighs World War II's Famed "Heavy," the Flying Fortress

North American's four-jet bomber can carry a bigger bomb load than the "Fort"—and at more than twice the speed. The Air Force rates it "in the 550-miles-per-hour class." Tornadoes can attack targets 800 miles away. This one thunders over California's high Sierras near Mount Whitney, left background.

"One day," recalled Robbins, "the boys over at Moses Lake came back here to Seattle and raided a junk yard down the street. They took the gyroscope from the autopilot of a wartime B-29 and rigged it up with a motor and control they got from the same place. They called the result 'Little Herbert,' just a device that senses the change of direction and counteracts the tendency to turn.

"Little Herbert is now a stowaway in the back part of the fuselage of every B-47 built. He makes it a steadier bombing platform."

This bomber has outrun at least one jet fighter and has averaged over 607 miles an hour in a flight across the continent. Yet, here at Boeing's Seattle plant, a bigger and potentially even better "bomber of the future," the secret XB-52, is being built as a possible successor to the huge B-36 (pages 300-301). Visitors are barred from the enclosure in which the new giant is taking shape.

U. S. Strives to Keep Its Lead in Quality of Planes

"We have to maintain the No. 1 Air Force of the world, with a heavier punch than anybody else, or the war will stop being cold," said four-star Gen. George C. Kenney, in Seattle to inspect the embryo bomber. (This was before the shooting started in Korea.)

"Numerically, we're behind. Technically, I think we can keep ahead. If we ever fall behind, there won't be time to catch up. No American airplane took part in World War II that wasn't already ordered into production at the time of Pearl Harbor."

Uncle Sam's money finances much of our progress in the air; nobody else could afford it.

Dollars spent for military planes keep the Nation's aircraft industry alive, solvent, and full of competitive enterprise. They pay for the great basic research in air-frame design, power plants, and missiles carried on by the National Advisory Committee for Aeronautics in ultramodern laboratories at Langley Air Force Base, near Newport News, Virginia; at Moffett Naval Air Station, near San Francisco; at Cleveland Airport (page 310);

← Up Pops a Human Jack-in-the-Box from a Plane Flying 555 Miles an Hour

Capt. Vincent Mazza of the Air Force explodes 60 feet high within a second in a test of the ejection seat used to enable flyers to escape from high-speed planes. Catapulted by a powder charge, seat and man both shoot skyward; then the seat is released and the flyer descends by parachute (page 311).

"If there is an unpleasant part to it, it is gone before you have time to realize it," said Captain Mazza, daring volunteer from the Air Force's Aero Medical Laboratory, Dayton, Ohio. He and Staff Sgt. Victor A. James made test ejections from this Lockheed T-33 jet trainer at air speeds ranging from 405 to 555 miles an hour last year over San Pablo Bay, California.

U. S. Air Force, Official

Four Engines, Eight Fans, Drive the World's First Turboprop Flying Boat

Two propellers, turning in opposite directions, absorb the 5,500 horsepower of each Allison gas-turbine engine. Unlike the turbojet (page 314), the turboprop harnesses the jet of hot gas to turn a turbine that drives propellers. Escaping, it also gives some jet thrust. Built for the Navy by Consolidated Vultee, the 60-ton flying boat XP5Y-1 takes off in a calm in less than 30 seconds. Top speed is "more than 350 miles per hour." Turboprop power is now being tried in transports (page 321).

and at Wallops Island, on the Virginia coast.

Results of all this research go to the armed services and to plane manufacturers.

Ultimately, the lessons learned reflect themselves in the planes of peace. This has been the story after both World Wars—in fact, ever since 1909 when the Wright brothers sold the first military plane to the Government and got a $5,000 bonus for exceeding by seven miles the specified speed, 40 miles an hour.

Some planes now have wings that can be altered in flight. I saw one type on the XB-51, racy three-jet light bomber made by Martin for the Air Force (page 304). On the ground the thin wings droop like a baby robin's.

"I still thrill every time I go out to look at the XB-51," said veteran plane-maker Glenn L. Martin.

Extend your arm from the shoulder, then turn it. That's how these "variable incidence" wings can be turned in flight—one way for most lift, as in take-offs and landings, the other for least drag at high speed. Thus the bomber combines the speed of a fighter with the ability to fly from smaller fields than a

plane so big and fast would otherwise need. Republic's radical new interceptor-fighter, the XF-91, also has adjustable wings (page 283).

Sharply backward-slanting wings, found best for today's phenomenal speeds, mark the Nation's newest jet fighting and bombing planes. First of these in production was the North American Sabre, which two years ago set an official world's record of a shade over 670 miles an hour (page 303).

"Will it fly faster than sound?" I asked a Sabre pilot.

"She's rated at .95," he replied, "but I believe she'll go over the Mach."

The modern airman's term "Mach," pronounced "Mock," comes from the late Ernst Mach, Austrian scientist. Instead of a speed in mere miles per hour, each plane now has its "Mach number." Mach 1 indicates the speed of sound; Mach .95 is 95 percent of it; Mach 2 would be twice it; and so on.

Strange Effects at Speed of Sound

As they approach Mach 1, pilots notice strange buffeting effects.

"The left wing gets heavy," said a fighter pilot, "the controls get mushy and stiff, and the nose begins to tuck under. That's where I quit." *

Why do such effects occur at the speed of sound?

"When you move your hand through the air, or when a plane flies at less than sonic speed, it sets up pressure waves like the waves from a stone tossed into a pool," explained Dee Wyatt, of the NACA's Lewis Flight Propulsion Laboratory at Cleveland. "They warn the air that something is coming, and the molecules start to move out of the way.

"These pressure waves travel at approximately the same speed as sound; so, when a plane flies as fast as sound, the air ahead has no warning. The result is a very abrupt change. We get shock waves as the airplane hits the molecules and the air flow changes its pattern."

"After you go through the sonic wall, everything's as smooth as a kitten's ear and as quiet as a mouse," said Gene May, Douglas test pilot, who has made many supersonic flights in the Navy Skyrocket. "All you can hear is the air stream and any noise that originates in the cockpit. You get the same effects coming out as you do when you go in."

Since a plane is made up of many surfaces, some more streamlined than others, the air flow may be supersonic over some parts and subsonic over others.

"It's as if," said May, "you had an automobile with four men in it and four engines, each driving one of the wheels. The effect is about like you would get if one driver was trying to go 35 miles an hour, another 20, the third 25, and the fourth maybe 10."

Racy streamlining of high-speed planes reduces the difference in rate of air flow over their various parts and helps them get through the wall with a minimum of buffeting.

Supersonic Test Pilot a Grandfather

May belies the popular impression that a man must be young to fly at such speeds. Though he looks as fit and aggressive as a welterweight boxer, he is 45, gray at the temples, and a grandfather. In the Skyrocket's pressurized, air-conditioned cabin he wears only chute and helmet in addition to ordinary street clothes.

"It's as comfortable to fly at supersonic speed at 10,000 feet," he says, "as it is to fly 300 miles an hour. The average person wouldn't know the difference. But if you're flying close to the deck, the ground looks like a grinding wheel turning under you."

I asked if he wasn't ever—well, a little bit perturbed.

"Once I was plenty scared," he said. "In the Skyrocket at Muroc I was flying an air speed calibration test at 575 miles an hour at control-tower altitude, checking the instrument's indicated speed against the actual speed over a measured course.

"Suddenly the two red fire-warning lights went on and the fire horn in the cockpit sounded. I went to 2,000 feet to kill my speed and to get enough altitude in case I had to bail out. I decided I didn't have time to make a normal upwind landing.

"'Clear the decks down there,' I called to the tower. 'I'm landing downwind.'

"I cut the engine, pulled the fire extinguishers, sideslipped in, and made a downwind landing at 240 miles an hour, blowing out a tire. The fire-warning lights were still on and the horn going.

"Then we found it was a false alarm, a short in the system!"

Nature's Gift to the Air Force

Eleven-mile-long, 7-mile-wide Muroc Dry Lake, 60 miles north of Los Angeles, is Nature-made for testing high-speed planes.

With the vision that later made him famous as commanding general of the Nation's aerial legions during World War II, the late General of the Air Force H. H. Arnold long ago saw the priceless possibilities of the enormous

* See "New Frontier in the Sky," by F. Barrows Colton, National Geographic Magazine, September, 1946.

Tailless, with Swept-back Wings Far Aft, Navy's Twin-jet Cutlass Carrier Fighter Shows the Eerie Shape of Things to Come

So strange in appearance is this "new look" plane that some bewildered newspapers printed its picture upside down. Speed is given by the Navy guardedly as "in the over 600-mile-an-hour class." Fuel sprayed into special stainless-steel tail pipes called "afterburners" gives bursts of superpower for quick take-offs and combat.

That the Cutlass, or F7U-1, is designed to fly at or near the speed of sound is shown by its knifelike slanting wings, so far back they seem almost an afterthought. At such tremendous speeds the turbulent wake of the wings may buffet the tail, so Chance Vought engineers omitted it completely. Instead, fins rise from the wings' trailing edge. Slats on the leading edge add lift for take-off and landing. Wheels nest in fin stubs under the wings.

The swordfish nose spike of this prototype is a boom carrying test instruments; spikeless air production models now roaring up from Chance Vought's Dallas, Texas, plant to join the Nation's first line of defense.

Needle-nosed for the Ultimate in Streamlining, This Sweptback Fighter Weighs Almost as Much as a 21-Seat DC-3 Airliner

A McDonnell Jet Parasite Fighter, the XF-85 Goblin, Trundles down a Loading Ramp for Tests of Attachment to a B-29


58588
58568
PN-590

Most Numerous of
All American Jets,
Lockheed F-80
Shooting Stars Shine
In Formation Flying

Big as a Superfort, Fast as a Fighter, New B-47 Bomber Rockets Skyward

Views of Drawings and Models at Work with Draftsmen and Wind-tunnel Models Preceede the Birth of a Modern Fighter or Bomber

Civilian Flyers Still Rely on the Eye in Travel Instead of a Bombsight as the Tool. Planes of Many Purposes Are the Ryan Navion (Above) and Piper Pacer (Below)

[illegible]

Observing Boat Guns Attack the Door to a Barred Section of a "Chinese"

Navy's Advanced Fighter Can Reach 40 Miles at Mach 4, But Misses

On Such Rafts, Ditched Flyers and Passengers Could Live for Days

Biggest Warplane in the World [illegible] B-19 Passes [illegible]

Iowa-Class Battleships Are Being Added, Making This Power Battleship a Formidable Combat

In the Rocket Ship Called the Bell X-1, Men Have Flown Hundreds of Miles Faster than Sound

[illegible]

World-record-breaking F-86 Sabre (Below) Now Has a Potent Snub-nosed Sister

[illegible]

[illegible]

Behind the Towering "T" Tail Crewmen Stow the XB-51 Jet Bomber's Parachute Brake

natural airfield formed by evaporation of mud-laden waters from the Mojave Desert hills.

Although it's an Air Force base, the Navy, the NACA, and plane makers, too, have the use of this flat expanse of clay, of the color and hardness of concrete.

By affording plenty of take-off room and a safe place to land for the fastest of planes, the Air Force says Muroc has saved the country many lives and untold millions of dollars. Without it even the bravest of pilots would have hesitated to fly the planes that have made a sieve of the sonic wall.

Engineer + Daredevil = Good Test Pilot

On the sunny desert day when I landed at Muroc from the east, the dry lake looked like a wet one. As I stood at one end and looked across, mirage turned its shimmering surface to what I would have sworn was water.

On the rare occasions when rain falls, flying—except from the adjoining concrete runways—has to wait till the sun drinks it up. The flat, cementlike surface of the dry lake is impervious to water.

Muroc, now Edwards Air Force Base, is named for a popular pilot killed in 1948 in the crash of a YB-49 flying wing, the weird batlike bodyless bomber which the Air Force ordered in numbers, then shelved in favor of more B-36's because of shortage of funds.

Test pilots here live so intimately with danger that they know it almost as a friend, or at least as a worthy opponent.

"The Air Force doesn't pay any bonuses," said one. "You have to really like to fly."

Often a lot of the engineer is mixed with the daredevil behind these old-young faces. Maj. Jackie Ridley, for example, has a master's degree in aeronautical engineering.

Natty young Maj. Frank Everest thought he should clear up a couple of points.

"Flying through the sonic wall doesn't make your hair fall out or anything," he said, grinning. "It doesn't make you any younger, either. We've tried it."

X-1 Pilot Sits in Sea of Nitrogen

Both of these men, and several others, have flown repeatedly in the supersonic Bell X-1. [illegible] forces that unknown [illegible] would be met at the wall, it was built to a strength of 18 G's—18 times gravity, its own weight. Eighteen planes like it could be stacked on its wings before they would break.

One wing of *Glamorous Glennis* was painted orange, the other white. Originally it was all orange, but white was found better for visual tracking and the white wing makes a good background for photographing tufts of yarn stuck to its surface. In flight an automatic camera takes pictures of how these tufts behave, thus giving data on air flow.

Breathing through an [illegible] the pilot sits in a sea of nitrogen which pressurizes the cabin. High-pressure nitrogen also drives the "lox" (liquid oxygen) and alcohol from tanks into the four rockets where the mixture explodes. Chief reason for the much greater expected speed of the Bell X-1A is a turbine pump instead of nitrogen pressure for fuel feed, increasing the time of full-power flight.

When I sat in the tiny cabin, my head bumped the top. I could see only up and straight ahead, not down (page 302).

On all X-1 flights a jet "chase plane" tags after the little bullet plane and helps it land. Though left far behind during rocket runs, it closely follows the X-1 as it comes in for a "dead stick" landing at 170 miles an hour, with all of its rockets exhausted.

"You're five feet above the ground. Hold it, hold it," says the chase pilot by radio.

Besides the high-speed research planes, most of the fast new Air Force fighters and bombers come here from the factories for their rigorous testing by the Air Materiel Command before acceptance. Later they go to Eglin Air Force Base, Florida, for tactical testing by the Proving Ground Command.

"Airborne Heavy Artillery" in Action

In the immense climatic hangar at Eglin, on the Gulf of Mexico, planes can be subjected to temperatures ranging from those of the Tropics to those of the top of the world.

"We check 'em for operational suitability—use 'em as they would be used in war," explained Col. Murray C. Woodbury, deputy commander. "We run 'em wide open and horse 'em around, then recommend changes in anything from tail pipe to gun sight."

"Jets are fine gunnery airplanes," said Lt. Col. J. T. Stewart. "In a prop-driven aircraft you have torque, the twist from the propeller. Make a dive-bombing run and you have to keep jiggling the rudder. Jets are torque-free at all speeds. It makes them wonderful gunnery platforms, particularly for rockets and strafing. They're making remarkable records for accuracy."

Fire-power demonstrations here are like the wrath of God. Fighter-bombers like the Thunderjet (page 319) are airborne heavy artillery. Each can fire 32 five-inch rockets while flying 500 to 600 miles an hour, or launch four "Tiny Tim" rockets, each with a war head that weighs 590 pounds.

High in Air B-50 Drinks Its Fill: Thus New-Age Bombers Can Circle World Nonstop

For dramatic effect, a World War II Flying Fortress first drops its dozen 500-pound bombs. Then comes today's thunderer, the B-36, dropping so many bombs that you feel the earth-shaking detonations will never stop. Then you remember that this is mild compared with the atom bomb!

Crew Calls B-36 an Air Battleship

Near Fort Worth, Texas, I saw these biggest bombers being born. They were coming off the assembly line in Consolidated Vultee's vast windowless plant, so long—three-fourths of a mile—that foremen ride motor scooters. All B-36's, old and new, now are getting four jet engines besides their six Pratt & Whitney piston engines with pusher-type propellers (pages 300-301).

From Carswell Air Force Base near by, these global bombers fly training missions that may keep them in the air a day and a half or more and cover the length and breadth of the country. One may be over your home town tonight, so high that you can't see or hear it; but even through clouds it can see your landmarks—a bend in a river, a bridge—with the re-echoing radio impulses of its sensitive radar.

"We don't think of it as an airplane," a captain told me. "We think of it as a flying battleship."

Like a battleship's is the elaborate fire-control system, with remotely controlled guns that can aim themselves eerily at unseen attackers by radar. The tail stands more than four stories high, and the fuselage has as many cubic feet of space as three five-room houses. To go aft for their share of "sack time" in one of the six bunks on long missions, men ride a scooter through a tunnel 85 feet long (page 304).

Maintaining and flying this majestic three-and-a-half-million-dollar mass of machinery is so immensely complicated that the keynote on a B-36 base is emotionless precision.

"Desert Boys" and "Flameouts"

In contrast was the Fighter School at Williams Air Force Base near Phoenix, Arizona. There the cloudless desert sky was full of young cadets in F-80 Lockheed Shooting Star jets, coming in for practice landings.

Desert dust flew up in a cloud as one jet landed just short of the concrete runway.

"There's a desert boy," said Col. Leon Gray, who watched each landing and winced or praised.

"Desert boys"—cadets who land short—must stand treat for their mates that night. Here there's plenty of room for inexpert landings, but on most fields a misjudged approach could cost the pilot's life.

Several fledglings made perfect landings, "painting it on" the runway as smoothly as if with an artist's brush. Then one came in far too fast to land.

"Take it around, take it around," the control tower told the cadet.

Far down the runway the F-80 was settling fast. Several tense seconds passed before the jet engine resumed full power and pushed the plane up out of danger for another, more successful, attempt.

"Why did the pilot wait so long?" I asked.

"A jet doesn't respond as quickly as a conventional airplane," explained the chief instructor, Maj. Charlie Cole. "If that boy had been too eager or scared and had rushed his throttle forward fast, he would have got what we call a 'flameout.' There's a rumble, and a big ball of fire comes out of the tail pipe. The engine is gone, its fire blown out.

"Sometimes it catches again, like the flame in a gas stove when you blow it. If not, the pilot's in real trouble."

Remarked one of the Acrojets, the base's crack aerobatic team: "Because of that time lag in a jet, you've got to think ahead of your plane—know what you're going to do before the time comes to do it."

Fuel Flows Like Water in Sink

Jet pilots must always know where they are. If they get lost, they may run out of fuel.

Jets burn gasoline or kerosene so fast that instead of an ordinary gauge they carry a liquidometer that constantly ticks off the number of gallons remaining. On missions pilots often must figure so closely that they reach their home base with only enough fuel for one go-around in case they misjudge the landing. Just for a second landing attempt an F-80 needs at least 22 gallons.

"When I'm flying low at full speed," an F-86 Sabre pilot told me, "I burn almost a gallon every four seconds."

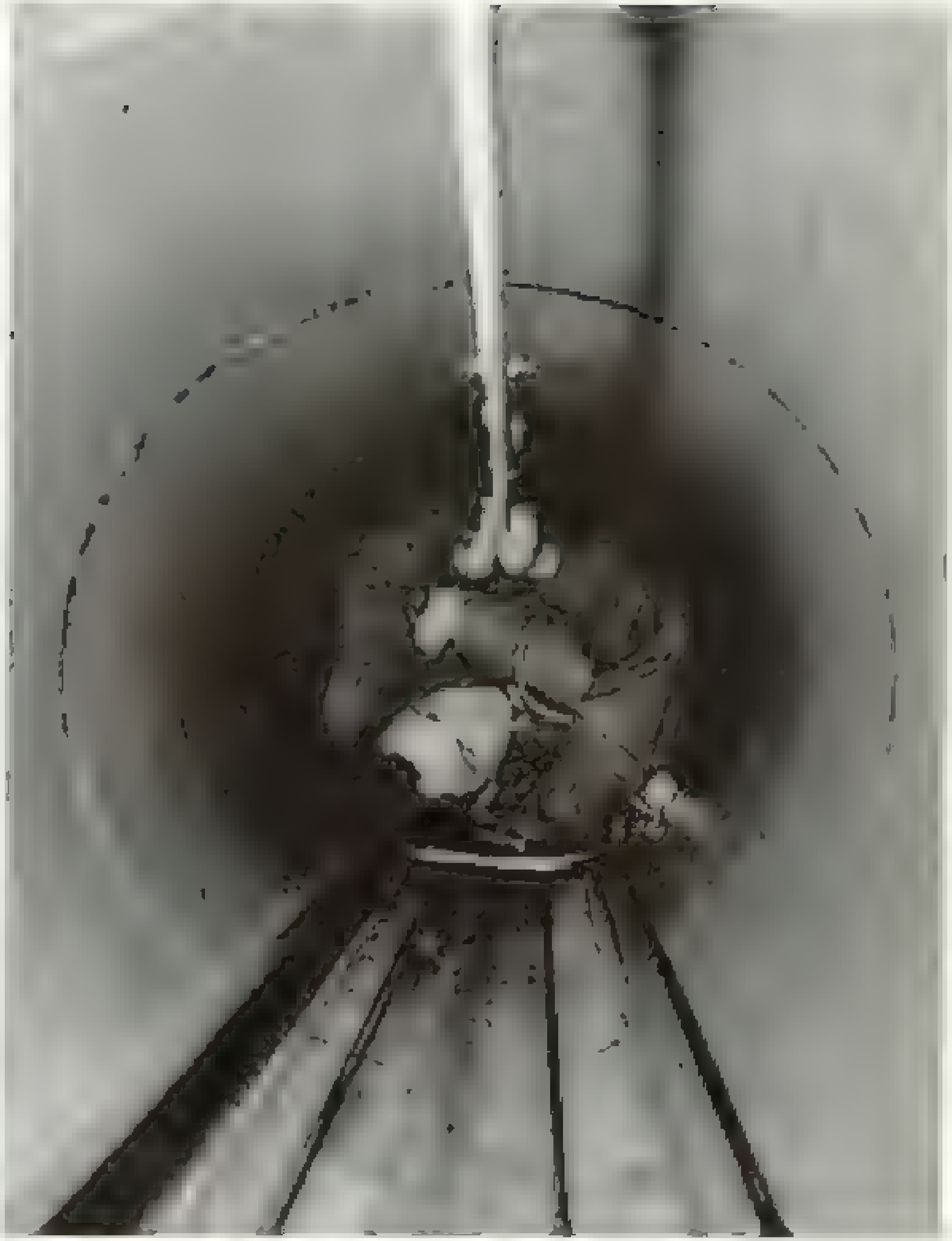
Fuel sprays into the engine at the rate of water from a wide-open kitchen faucet.

Both rockets and jets push a plane along by the time-honored Isaac Newton law of physics that to every action there is an equal and opposite reaction. The motion of the plane is the opposite reaction to the blast of hot gases, like the recoil of a gun. Rockets differ from jets chiefly in the fact that they burn different fuel and carry their own oxygen.

No jet is efficient in fuel consumption at low speed and low altitude. Approaching a landing field at 200 miles an hour, it burns about as much as it would at 600 at 40,000

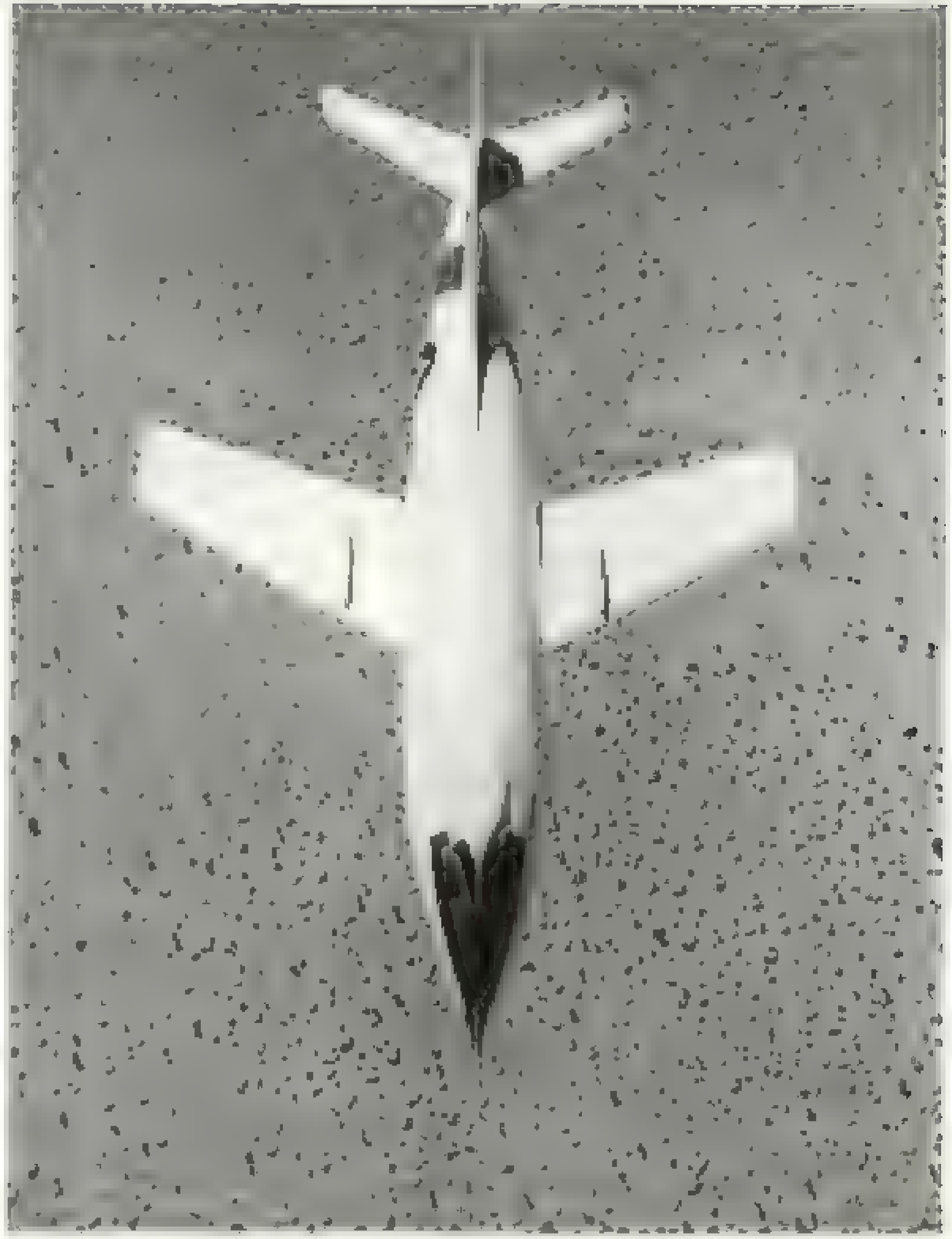
Even Planes Now Wear Parachutes — Plenty Dent Across, a Rubber Chute Braces a Boeing Stratojet Bomber to an Excessive 5 Landing

Take the Whole Swallowing Jonah: Globemaster's Clamshell Jaws Gobble Truck Weighing 5 Tons and Tank Weighing 17,



In the Bowels of a B-36 Bomber an Airman Rides a Scooter

[illegible]



Navy's Sleek Skyrocket Explores the Realm of Superspeed

[illegible]

A Scientist Peers at a Rumbler: Its Thunder Is Heard Miles Away

[illegible] call their jets "blowtorches," [illegible] or just "cans." One hears such instructions from the control tower as "[illegible] down your wick and come on in." [illegible] have been quick to spot the likeness to a big kerosene stove.

"Hot seat" is another new air term. It refers to the ejection seat used in jet fighters when the device is "armed"—ready to fire."

Last word of the mechanic to the jet pilot is, "The seat's hot. Be careful." He means that the explosive charge is in place and the safety cotter pin removed.

Jets' "Hot Seat" Saves Lives

At the high speeds usually flown by jets a pilot would have little chance of jumping clear. Even if the fierce air stream would let him out he might be struck and killed by the tail. The ejection seat explodes him out—60 feet high in a second (page 28).

Both Air Force and Navy have training towers where new jet pilots can ride the hot seat. At the Navy's Mustin Field, in Philadelphia, I saw this "fired from a gun" routine.

A cartridge like the shell of a small cannon was inserted beneath a seat on vertical tracks running up the steel tower. When the man in it yanked down a stiff curtain over his face he tripped a trigger that fired the charge. One second he was sitting at the foot of the tower; the next he was 45 feet up.

"For these tests the charge is lighter than used in a plane," said the smiling hero as projectile when he was lowered—much more slowly. "Even the full charge isn't too bad. It's not much worse than falling down hard on your seat when ice skating."

In the first 40 inches the rider goes from zero to 40 miles an hour, straight up. For a fifth of a second he is subjected to a force of 18 to 20 times his own weight (the pressure on the seat of the pants of a 200-pound man is 3,600 to 4,000 pounds); but this is so brief it does no harm to a man in good health.

Like the British, the Navy uses the curtain chiefly to protect the face from the furious blast of the air stream at 500 or 600 miles an hour. Experiments with winds of much slower speed show that they make the flesh on the face ripple like a flag in a breeze. The Air Force uses no curtain, having decided the air blast is too great to be harmful. Both types of seat have saved lives.

Last year Second Lt. Dick O'Leary had trouble with the elevator controls of his jet fighter while flying from March Air Force Base, California. Deciding to bail out by ejection seat he tried to jettison his cockpit canopy. But that transparent lid stubbornly refused to budge. At last he was forced to crash-land in a wheat field.

The instant the plane hit the ground the seat fired, exploding the pilot back into the air. He fell with at least as much force as if he had fallen off a house and was badly injured. But being blown free undoubtedly saved his life; the plane was a total loss.

For high-altitude escape, the Navy is trying a new idea which it calls the "escapsule" cockpit. Not the seat but the whole enclosed cabin in which the pilot sits is blown free. Three tail fins stabilize this streamlined capsule which looks like a small wingless plane. Still pressurized, it provides breathable air and protection from the intense cold. Parachutes bring it down slowly, and if it alights on water it floats like a boat.

"I hope we get something like that soon," said a test flying Bluejacket pilot I talked with at the U. S. Naval Air Test Center, Patuxent River, Maryland.

"At present, if you bail out above 35,000 feet you might as well give up. You'd freeze before you got down."

At the Navy's Mustin Field and Patuxent, and at Wright-Patterson Air Force Base, Dayton, not only planes and materiel are tested, but also the tolerance of the human body. Today's high speeds, and the much greater ones foreseen in aviation's tomorrow, make this of major importance.

How It Feels to Black Out

Gravity forces, or G's, brought to bear on a pilot when he pulls out of a dive at 500 or 600 miles an hour are so great that he may black out—go blind temporarily—forget where he is, and become unconscious. All this can happen before you can count to ten.

The reason is that, with a gravity pull of several times a man's weight, the heart can no longer pump blood uphill to the eyes and brain. The effect is as if your neck suddenly became several times as long as it is. Blood "pools" in the lower part of the body.

Test pilot Gene May had told me how it feels:

"First you gray out—the day looks darker—and your vision narrows till you can see only straight ahead. An inexperienced man may get hysterical, black out, and faint. The same would happen to an experienced pilot if the G forces continued. But, being familiar with the symptoms, he eases the pull-out, reducing the forces, and promptly returns to normal."

* See "Our Air Age Speeds Ahead," by P. Harrison [illegible]

Tensing the muscles reduces the pooling of blood in the lower body and enables a man to withstand more G's than normally. But since this would be too exhausting in combat, fighter pilots wear "G suits" with rubber bladders that help by automatically pressing against the legs and abdomen.

To study these effects, specialists in aviation medicine have contrived human centrifuges that spin a man at 25 or 30 miles an hour. To see how it feels to black out, I rode the centrifuge in the Aero Medical Laboratory at Wright-Patterson. The device is a long metal frame pivoted in the middle and whirled by a 250-horsepower electric motor.

Riding a Human Centrifuge

Though I felt like a voluntary guinea pig, I was escorted to the "human" end and buckled to a seat in a little cab, pivoted to swing out horizontally when this super merry-go-round starts to turn.

On a panel directly in front of me gleamed two small electric lights. Near the sides of the panel were two others. One of the lights in the middle was constant. The other three lights I could turn off by switches in a grip clutched in my right hand.

"Always look at the lights straight ahead," directed the major-domo of the centrifuge, aeroscientist Ernest K. Martin. "You'll see the other two out of the corners of your eyes.

"Every time you see a light come on, it's up to you to turn it off. If you don't turn them off, I'll know you've blacked out and can't see them. Automatically I'll sound this buzzer. If you don't turn it off, I'll know you're unconscious."

Carefully he explained that I must relax completely to find my true G tolerance.

He took his seat at the center of the centrifuge, like a merry-go-round motorman.

"My eyes will be on you every second," came his voice through a loud-speaker in the cab. "Just relax now. Pretend you're sitting in an armchair at home."

He gave the word to apply power.

Suddenly I was driven down into my seat; my head swung forward, seemed to weigh 50 pounds. Lights came on. I turned them off. Those at the sides looked a bit dimmer. As the whirling ceased I seemed to be pitching end over end, down and down.

Grinning, Mr. Martin opened the door.

"That pitching sensation," he said, "results from the fact that the cab swings back to the vertical from the horizontal when the centrifuge stops. After a few rides you won't feel it."

I told him I thought my marginal vision had grayed a bit. (I felt as if my temples had, too.)

We tried it three more times, faster, and my tolerance proved to be about average, just under four G's. Each ride lasts only 15 seconds but seems longer.

Once the operator stopped the centrifuge after only eight seconds—an emergency stop. In that brief time I had reached the point where I failed to respond to lights or buzzer and was in a confused state on the threshold of unconsciousness.

As the cab swung to a stop, I realized that the buzzer was going—had been buzzing a long time, it seemed—and I rather peevishly switched it off, as a sleepy man turns off an alarm clock. I'm glad I wasn't flying a plane in that groggy state.

Research with the centrifuge shows that a man lying down can stand about twice as many G's as one who is sitting. At Wright-Patterson I saw a berthlike device on which a pilot would lie prone. Its use may come when planes fly even faster than today.

At Muroc the Air Force has a "human decelerator" to test the forces imposed on airmen by the sudden stop of a crash landing. A rail car riddled the "human rod" is blasted by rockets to a speed of 200 miles an hour, then abruptly brought to a controlled stop by brakes in the rails.

One recommendation resulting from these tests is that future Air Force passenger-type aircraft have seats facing the rear. If they crash-land, occupants have a better chance if braced by the back of the seat.

Plane Tortured as if on the Rack

Aircraft companies make equally exhaustive tests to see how much their planes can stand. In the Chance Vought factory at Dallas I saw the first Navy F7U Cutlass off the assembly line undergoing structural torture. Factory men dropped it from various heights. Heavy pulls were applied to its wings and body, much as human victims in the Middle Ages were stretched on the rack.

"That one's built to be destroyed," said one. "We load it down till it breaks."

Factory manager Bert Talliaferro grimaced.

"Every time they drop it," he said, "and every time they tweak it, I suffer for fear something will break before its time. If it does, I have to go into the entrails and strengthen it."

With all these jet fighters and bombers, one expects to see at least one propellerless transport. In all the United States there is none. Plane makers say they can't afford the gamble—20 to 40 million dollars.

Marines Show How a Hovering Sikorsky "Windmill" Hoists Men to Safety from the Sea

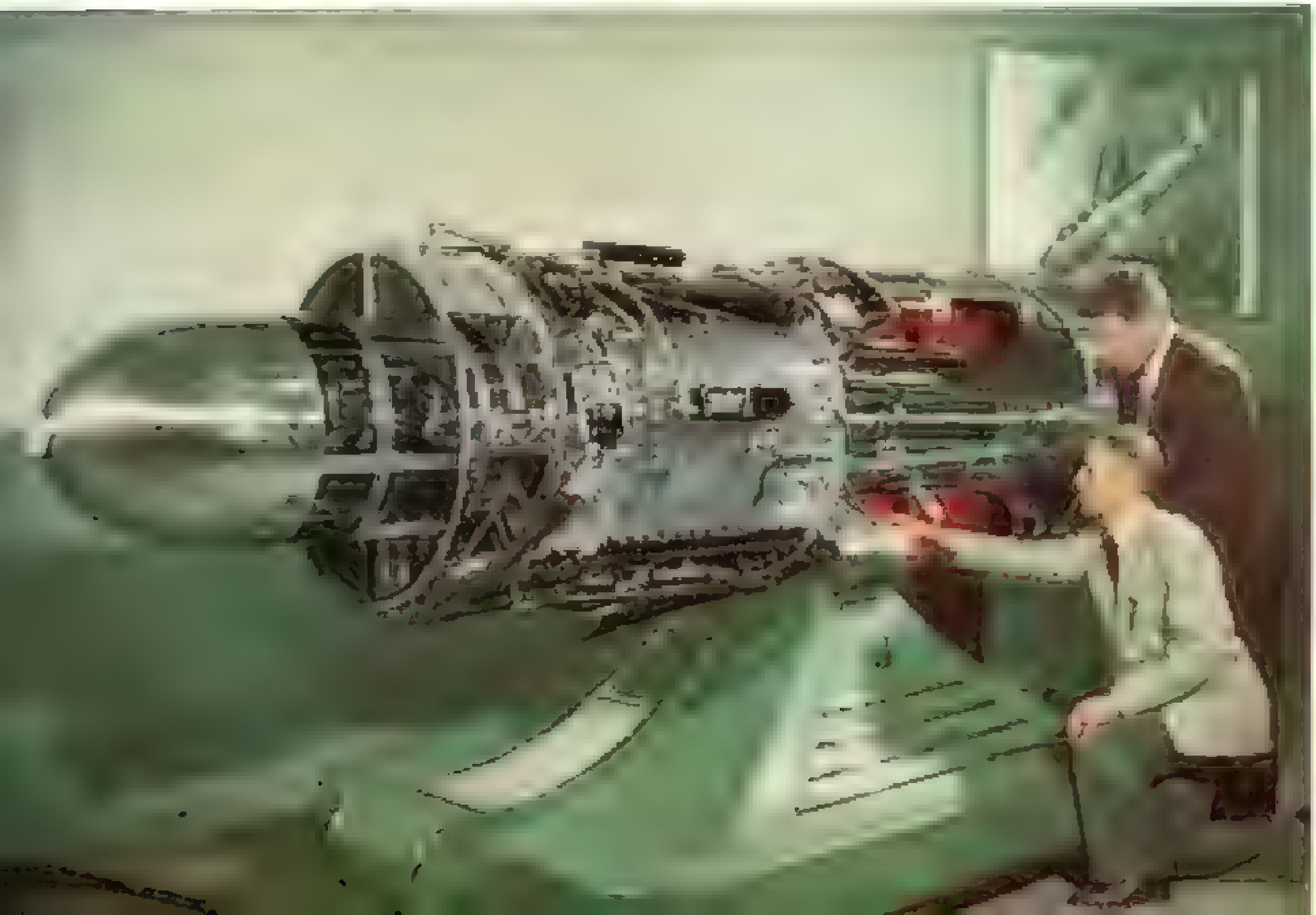
When [illegible] battleships, and most cruisers, helicopters answer the "man [illegible]" [illegible] from ship to ship dessert mail, [illegible] scouting. During combat take-offs and landings, the [illegible] crossed a vivid green fog a dye used to attract rescue planes

▲ Flying Ribbons Dramatize the Danger of Being Sucked into a Jet's Nose

[illegible]

▼ A Cutaway of General Electric's J-47 Engine Shows How a Turbojet Works

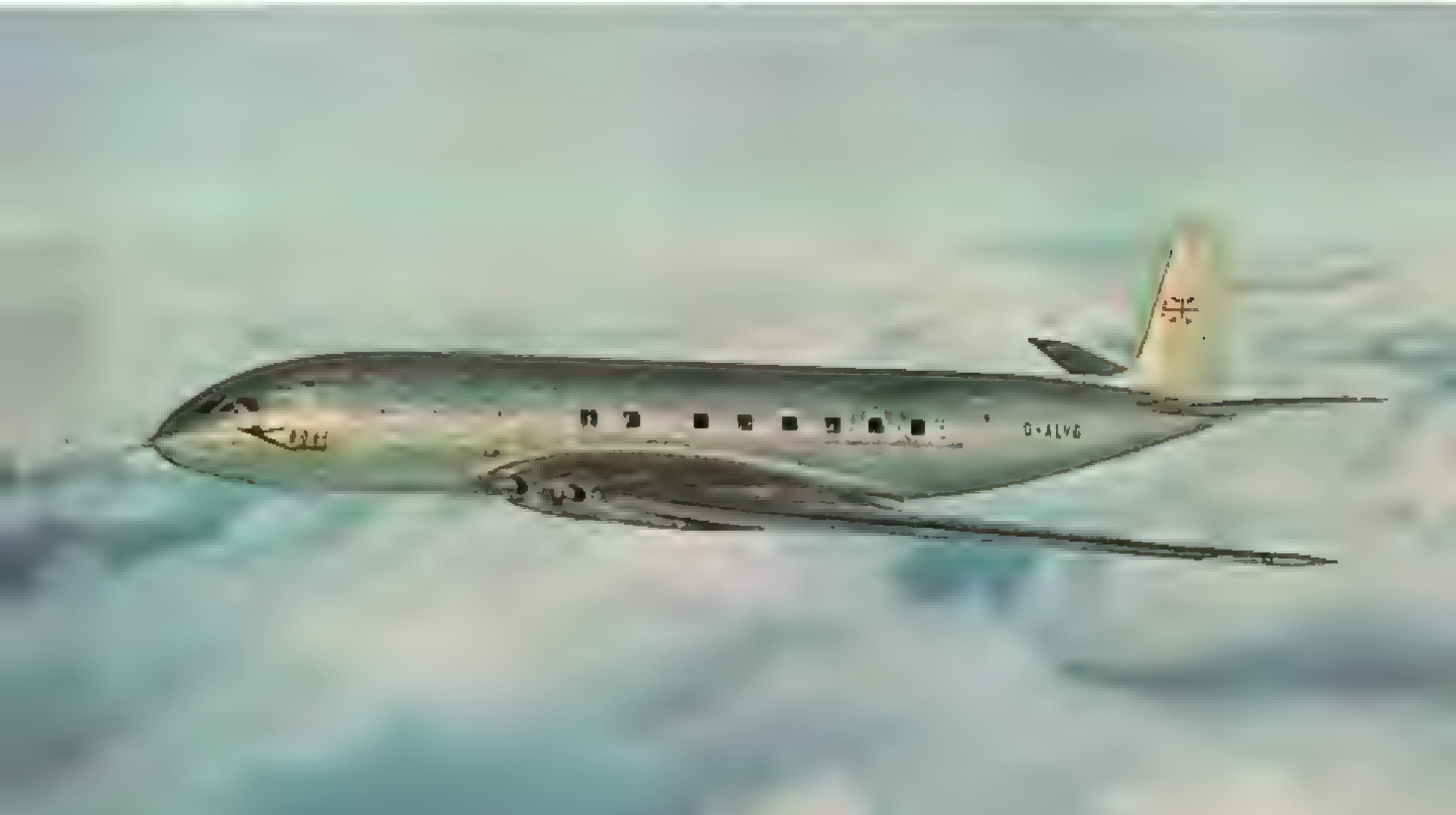
[illegible]



Encounter at a Possible New Type of Fighter In This Russian Developed Design

That Long, Slim, Nose Houses a Powerful Radar: Air Force's F-89J Night or Bad-weather Fighter Must "Smell Out" Enemy Planes

Britain's de-passenger de Havilland Comet Worldʼs First Jet-propelled Airliner Serves Notice That "The British Are Coming"



[illegible] Tail Makes This New All-weather Fighter Look Like an Angry Scorpion

Northern Thunderjets Rust Up at the Republic Plant on Long Island to Join Hundreds on Duty with Air Force Squadrons

Does an Insect Itself, a Bell Helicopter Ruins Death on Adirondack Black Flies

Give them an order and they will build [illegible] or as many as you can pay for. But [illegible] not investing that kind of money in jets as yet. There are too many problems to be licked, they say, in operating pure-jet transports with the air navigation system we have today. For example, you get "stack ups" of jets waiting to land. At low speed and altitude they burn up too much fuel.

Turboprop Harnesses Jet to Propeller

All admit that the pure-jet airliner will come, but meanwhile some American companies favor the gas-turbine "turboprop." This [illegible] the turbojet's blast of hot gases to turn a propeller instead of using its power purely as jet thrust (pages 287 and 314). Such engines are vibrationless compared with the piston engine.

With the turboprop its advocates predict airliner speeds up to 500 miles an hour or even more. The British are building planes of this type, and in this country several companies are planning to replace piston engines with turboprop power.

Consolidated Vultee's revolutionary new turboprop flying boat made its first flights last spring, and Douglas revealed in June that it is flight-testing a powerful new Navy carrier-type attack plane, the XA2D Skyshark. Both are driven by the 5,500-horsepower turn-jet gas-turbine engine built by the Allison Division of General Motors.

Meeting the challenge of the jet, propeller makers are developing blades so thin but strong, with knifelike edges that they work without too much loss of efficiency when their tips are traveling at supersonic speeds. Engineers of Hamilton Standard Division of United Aircraft say new blade designs in wind-tunnel tests have operated at 80 per-cent efficiency at airplane speeds up to 900 miles an hour at sea level.

In the battle with the jet the propeller is still on its feet and fighting, the turboprop opens a new field for it, and for most purposes the economical old piston engine retains its hold. Long range must piston-engined F-51 and F-82 fighters, as well as bombers, useful to our forces fighting in Korea.

Latest development in cargo carrying is the use of large streamlined "pods" carried under the fuselage and quickly detached when the plane lands. The Fairchild XC-120 experimental "pack plane" for the Air Force, this big detachable cargo van makes up the whole lower two-thirds of the fuselage.

Piasecki Helicopter Corporation, maker of the twin-rotor "flying banana," foresees copters picking up such pods at airports and flying them into town. For the military it is outlining a pod-carrying copter, the XH-16, about as big as a four-engined airliner.

As befits the homeland of Sir Frank Whittle, pioneer of jet propulsion, Great Britain [illegible] the world's first jet airliner, the passenger de Havilland Comet (page 317). How does it feel to ride in the Comet at nearly 500 miles an hour, eight miles above the earth? From England comes this piquant picture:

"Paradoxically, there is a sensation of being poised motionless in space. Because of the great height, the scene below scarcely appears to move, because of the stability of the atmosphere, the aircraft remains rock-steady. The gas turbine's complete freedom from vibration is unexpected in a vehicle of great power, and the absence of all visible signs of engines, propellers, or other moving parts completes the illusion."

At New York last spring I saw the first jet transport in this hemisphere, the Avro [illegible]. The low-slung four-jet Canadian airliner, designed to carry as many as 60 passengers, had just flown the 365 miles from Toronto in four seconds less than an hour.

Today's propellerless planes are driven by the turbojet, which uses a turbine to compress the air in which fuel is burned (page 314). Producers in this country are Allison, General Electric, Pratt & Whitney, and Westinghouse.

Ramjets Drive Missiles and Helicopters

A real Buck Rogers device is the tremendously fast and powerful ramjet engine. Unlike the turbojet, it needs no air compressor. Essentially a fire in a flying stovepipe, the ramjet gets its name from the fact that the air is rammed through it and compressed by the sheer speed of its flight.

Ramjets do not begin to work well until they near the speed of sound. In missiles rocket power gives them their initial boost. In airplanes of the future, engineers say, the turbojet might be teamed with the ramjet, the latter taking over at about the speed of sound. But first a way would have to be found to moderate the heat resulting from friction of air on such a man-made meteor.

Big ramjet engines pack so much power that in "hot runs" tests at Daingerfield, Texas, and Cleveland (page 310) they rattle windows and dishes two to four miles away. At the Wright plant in Mount Kisco, New Jersey, it takes a big battery of silencers, heavy springs, and 120 tons of concrete foundation to stifle the ramjet's roar so it won't break dishes,

Past Golden Gate Bridge Flies a Navy Neptune, Long-range Guardian of the Seas

[illegible] Neptune, [illegible] *Turtle*, set a world record of [illegible]

crack buildings, and deafen the [illegible]

For helicopters the ramjet has already proved practical because the rotor blades that lift and propel them revolve at high enough speeds. Ramjets mounted directly on the blades cause them to turn.

In St. Louis, the McDonnell Aircraft Corporation points with parental pride to its sprightly offspring, "Little Henry," which it calls the world's first successful ramjet helicopter. Its development was [illegible] Air Force. Two tiny 10-pound [illegible] on the rotor blades enable Little Henry to flit about like a bird.

Howard Hughes, in California, is developing for the Air Force a "flying crane," a jet-powered helicopter so large that, if successful, it might be used to lift trucks, bridge sections or even an Army tank across a mountain.

Two turbojet engines are mounted in the fuselage. From there, compressed air at high pressure is channeled to the tips of the rotor blades where it is mixed with fuel and burned, making the rotor revolve on much the same principle as a rotary lawn sprinkler. Jet thrust can be used to propel the novel craft [illegible].

In close secrecy, nuclear physicists and aircraft engine experts are working on the problem of atomic power for airplanes. If such a plane is designed, its range, they believe, will be virtually limitless.

No wonder airmen feel and talk like Air Force Maj. Charlie Cole, at Williams in Arizona: "General Arnold and General Spaatz were in on the ground floor in their day and saw the development of propeller aviation all the way up. We're in on the ground floor of something even bigger. The limit is as far as you can see the stars."

Sea to Lakes on the St. Lawrence

By George W. Long

Photographs by [illegible] and John E. Fletcher

M. B. *McLeay*, powerful Canadian [illegible] her berth at Sorel and headed up the ice-choked St. Lawrence River in the cold, gray dawn. An hour later, snug in my bunk, I was catapulted into consciousness when her reinforced bow ram met head-on 24 inches of snow-topped ice, end of the previous day's run.

Probing, feinting, battering, *McLeay* mounted a relentless offensive (page 362). Dusk found the sturdy ship six hard-won miles nearer her objective—Montreal Harbor, silent and white in winter's grip.

"Looks like an early opening this year," said Herb Land, Department of Transport engineer, as we watched the battle from the bridge.

"Can't tell, though," he added. "We may hit a jam tomorrow and make only 500 feet."

Over mugs of scalding tea Herb and I talked ice breaking on the St. Lawrence.

"Below Quebec the river never freezes over solid. Above the city the ice is shore-to-shore, and jams form sometimes 80 feet thick.

"Before we had breakers the jams acted like dams, and there were serious floods. Now we start in early February, clear the channel to Montreal, and keep the ice moving. We haven't had a big flood in over 20 years."

"I thought this icebreaking was done to free the port of Montreal for shipping," I said.

"It helps that way, too," Herb answered. "Since 1908, when icebreaking began here, we've added almost two weeks to the navigation season. That means a lot to a big port like Montreal."

Open Channel Forecasts Spring

First signs of spring along the St. Lawrence are these big breakers pounding at ice jams. Montreal newspapers publish daily [illegible] of their progress, readers follow them as U. S. sports fans follow the standing of their city's ball team. Montrealers take a personal pride in this annual victory over Nature when headlines shout "Channel Open to Quebec!"

Then river ports begin to stir. Riveting and hammering sound on awakening water fronts. Channel markers are set in place; range lights begin to blink. Canada's great highway of ocean trade is opening for business.

Navigation begins about April 15. Usually, some days before, venturesome ships rise the last remnants of ice to gulf and river. Their skippers race for the gold-headed cane Montreal awards each spring to the captain of the first overseas vessel in port. In 1949 Capt. A. S. Baxter, of the *Mont Alto*, set an all-time record by docking April 7 (page 347).

The force of a continent flows in this awakening River St. Lawrence. Maps confine its name to the majestic channel coursing north and east that siphons the Great Lakes. Actually, its source is the little St. Louis River flowing into Lake Superior's western tip. The Great Lakes are but gigantic widenings in a river system that spans half of North America and drains an area almost as large as Alaska (map, pages 336-7).

Great Lakes Control River's Flow

These vast lakes mold the river's character. Immense settling basins, they spill a clear and sparkling flood almost free of silt. Huge natural reservoirs, they keep its flow more constant than any other large river's.

No "Ol' Man River" this—no seasonal rampages, no course-changing whimsy, no muddy cargo carried to a seaside delta. Vexed only by rapids in its upper reaches, the St. Lawrence flows from the heart of America to the [illegible].

Jacques Cartier, bold Breton sea captain, discovered this wide crack in the New World more than 400 years ago. Then France sought a short cut to the Fabulous Indies. Reconnoitering the gulf in 1534, Cartier thought the prize was his.

Returning the next year, he beat his way upriver 1,000 miles to the present site of Montreal. Near by, foaming rapids dashed [illegible]. Cartier had found not a Northwest [illegible] distant Cathay but a midwest passage leading to the interior of a vast continent.

Cartier's midwest passage gave later Frenchmen the key to a continent. Connecting by easy portages with other vast watersheds, it opened America from the upper Ohio to the Rockies and from Hudson Bay to the Gulf of Mexico.

While Maine-to-Georgia mountains dammed the tide of English colonists, the French saddled their swift canoes over a far-flung inland empire.

For 150 years New France, confined in the St. Lawrence Valley, lived on its geographic monopoly. Lusty voyageurs, trapping the

Author George Long (Left) Interviews Officers of the *North Shore* in Quebec

[illegible]

western wilderness. [illegible] with the Indians each year sent a king's ransom in gold and [illegible] of Europe. [illegible] waiting [illegible] to Europe.

When French Canada became British, [illegible] took over the trade. When [illegible] took its place, [illegible] were floated down the Ottawa and St. Lawrence Rivers to be loaded [illegible] in Quebec.

Ocean Ships 1,000 Miles Inland

As Canada opened her prairie [illegible] Great Lakes and great river the [illegible] still [illegible].

Today the [illegible] of [illegible] and [illegible] is the [illegible] gateway to the world for all of Canada between the Rockies and the Maritime Provinces. Freighters, half [illegible] Lakes and [illegible].

[illegible]

Several thousand miles traveled up and down the magnificent waterway unfolded for me [illegible].

[illegible] and [illegible] splendid cathedrals.

A [illegible] of characters—monks, [illegible], soldiers, Indians, priests [illegible]

Prince Knows the Trucking Business; He Enjoys Hauling Cod

tourists, pilgrims—gave the scene life; the river gave it unity.

Hot weather found me in flannel shirt and heavy sweater on the S.S. *North Shore*, cruising [illegible] northern shore of the St. Lawrence [illegible] mouth.

On [illegible] lay the small [illegible] Cartier named the Saint Lawrence in 1535. [illegible] the "Great River of Canada" [illegible] name spread from Newfoundland to Lake Ontario.

Cartier thought this desolate north coast must be "the land God gave to Cain." Barren, lonely, it skirts a vast savagery of [illegible].

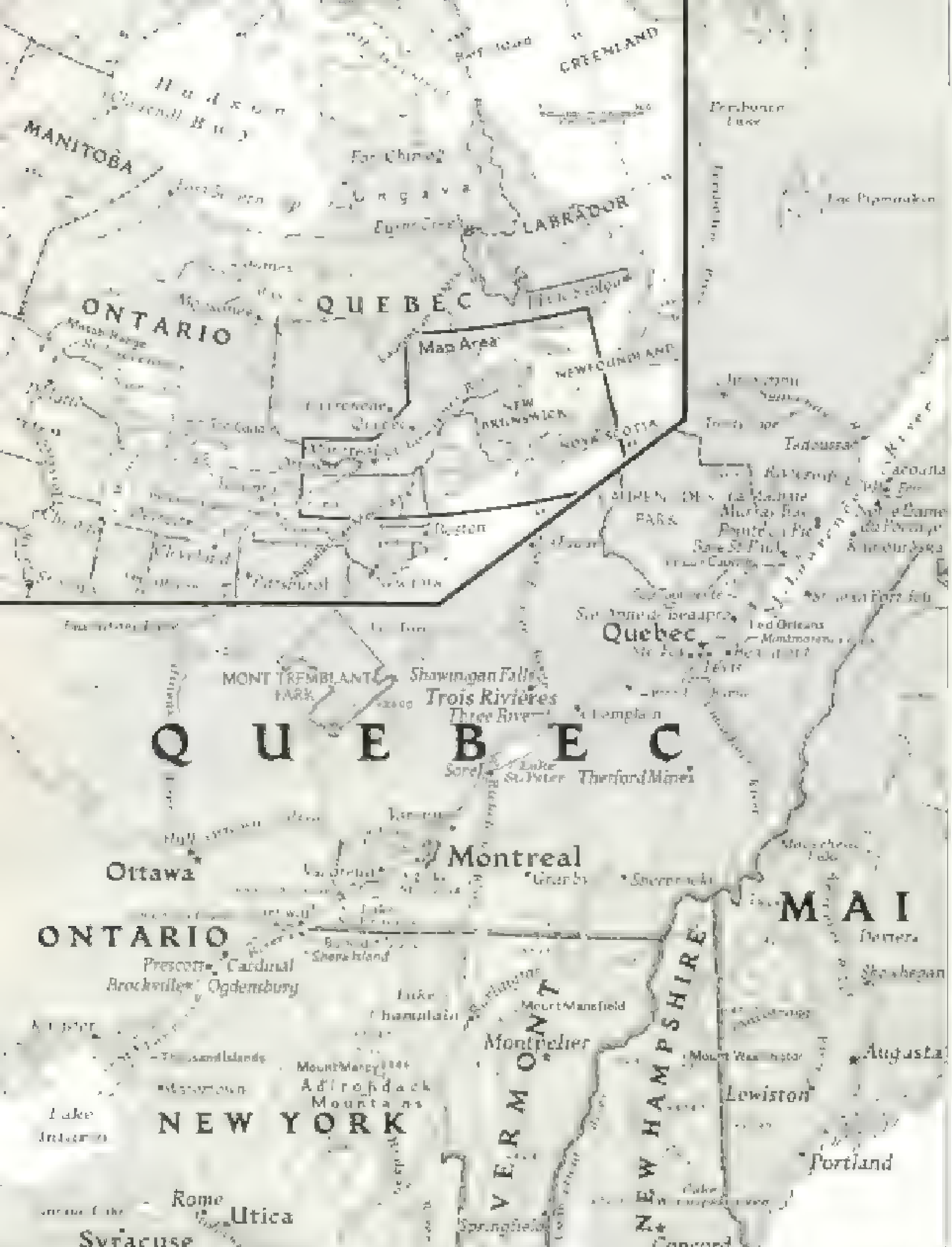
[illegible] outposts [illegible] wilderness [illegible] to Hudson Strait and the Labrador [illegible] playful whales spouted [illegible] at a time we saw [illegible].

[illegible] were our brief [illegible] with the towns [illegible]. [illegible] French, a jovial greeting and good-natured [illegible] mingled with deck hands' and dock workers' shouts. Protesting squeals, squawks, and baas [illegible] the winch's clatter as it transferred a Noah's Ark [illegible].

Across the gangplank stepped priests and [illegible], traveling salesmen, [illegible], sportsmen, local people in [illegible], and leg-stretching tourists.

A Land Rich in Iron Ore

At Seven Islands (Sept Îles), sizable by north shore standards, we heard how this bleak land has yielded one of the great iron discoveries of all time. [illegible] prospectors [illegible] eastward [illegible] the



Coursing Northeast, the St. Lawrence Drains the Great Lakes' Brimming Basins

[illegible]

Gaspé Peninsula

Gulf of St. Lawrence

Anticosti Island

NEW BRUNSWICK

PRINCE EDWARD ISLAND

NOVA SCOTIA

Bay of Fundy

Atlantic Ocean

Cape Breton Island

Proposed St. Lawrence Waterway Would Turn Midwest Cities into Seaports

Quebec-Labrador boundary, have proved 357 million tons of high-grade, easily accessible iron ore. To date they have tested only a fraction of the ore-rich Labrador trough in places where the ore thrusts naked to the surface.

As rich or richer than Minnesota's famed Mesabi Range, depleted by two wars, the new find poses tough transportation problems. It's a long haul from Ungava to the blast furnaces.

Present plans call for a 360-mile railroad south to deep-water Seven Islands. There the St. Lawrence will take over the job of getting this fat industrial pig to market.*

Farther east I had already seen one effect of this shore's newly opened treasure chest. Havre St. Pierre, remote river "metropolis," was booming like a Klondike town of 50 years ago. Pile drivers hammered foundations for a big new wharf. Earth movers strained and men labored to push a railroad inland.

Not gold but millions of tons of titanium ore had boosted the town's temperature.

Known until a few years ago chiefly as a white powder used in making paint, titanium can now be produced in pure-rare metal form. As such it is 70 percent heavier but six times stronger than aluminum, 40 percent lighter and about equal to steel in strength. Remarkably resistant to corrosion, this middleweight metal promises to play a vital role in modern technology.

From Seven Islands we traced a wide-sweeping coast that curved south. As we rounded Pointe des Monts, I climbed the bridge.

"Know where the river's mouth is?" the captain asked.

"Well, the Canadian Geographical Board and a royal proclamation of 1763 say it's at the western end of Anticosti Island," I answered.

"Sounds impressive," said the skipper, "but most rivermen will say it's right here. At Anticosti it's 100 miles across; only 28 here. Some people say the mouth's at Father Point, where pilots board deep-sea ships. I even know a fellow who says it's at Quebec City. Anyway, it's a tough river to tie down."

Later I heard all these opinions and more. But I had to agree with the captain. Here, with both shores in sight, the incoming traveler gets his first feel of the river.

Baie Comeau, Paper-mark City

On the shores flanking Pointe des Monts *la pulpe* is big business. At every harbor flumes float logs ashore and spit them into boats (page 349).

The chief town, Baie Comeau, held plenty of surprises—paved streets, fine hotels, cathedral, streamlined store fronts, hospital. Its 3,000 people find recreation in a big community center, gymnasium, sports arena, curling [illegible] and rink.

Two newspaper interests built the town in a howling wilderness little more than a dozen years ago. Its fast paper machines roll out 150,000 tons of newsprint a year for big New York and Chicago dailies.

More than half of Canada's vast newsprint [illegible]. Pulpwood "mountains," stored against the winter freeze-up, are a river trademark. Characteristic sight (and Christmastime smell) is a St. Lawrence pulp boat, barked pine, spruce, and balsam logs stacked on deck.

Pulp Boats Are Family Affairs

Sunrise to dusk, these workaday tramps parade the lower St. Lawrence, their Diesels hammering the air. Linking small ports and big mills, they haul forests of pulpwood. Sharp-prowed, round of stern, their lines come down from 17th-century Breton ships. In size they approximate the vessels that Cartier sailed.

French Canadian to the keel, they bear such names as *Gaspésienne*, *Mer*, *Mont Laurentien*. Often as not their skippers sail *en famille*. Madame cooks, does the "housework," takes her turn at the wheel. Children may romp the decks, and dishes fest on the lines.

Deep-sea skippers snort at these boats.

"In them' we call 'em," one veteran captain told me, "and don't ask me why. Bloody nuisance they are, too. Their crews are as independent as their Norman ancestors; may cut right across your bow just for fun."

Slowly the great river narrows. State-blue Laurentians, crowding shoreward, raise a frowning coastal wall. Splitting these reluctant hills, the deep-volumed Saguenay River pours from its fjordlike chasm.

Later I took the popular Saguenay cruise. To storied Tadoussac, at this amazing tributary's mouth, I glimpsed a bit of Canada's early history. Long before Quebec was founded, Tadoussac was a rendezvous of Basque whale fishers and French fur traders.

I visited the old Indian chapel and rang its 1647 bell. I studied curious Indian artifacts in a stockaded log museum, replica of Canada's first habitation, a trading post built on this very spot in 1600.

Montagnais Indians, summering here, told Cartier whopping tales of a fabulous "kingdom of the Saguenay," where wool-clad white men lived and gold abounded.

* See "Quebec's Forests, Farms, and Frontiers," by Andrew H. Brown, National Geographic Magazine, October 1949.

High Above the St. Lawrence Perches Quebec, Once the Cornerstone of New France

Thick-walled Mills Doubled as Forts on Isolated Ile aux Coudres

[illegible]

From a Yawning Outdoor Oven Comes a Household's Bread Supply

[illegible]

Rugged Power.—Veteran of 81 Years Scouts the Rock-tossed Waters of the Long Sault.

Sendas Packackers on Shore Island Get a Grandstand View of Her Spectacular Dash

Early Students of Queen's University Partake Their Steps on the Breezeswept Shores of Lake Ontario.

Old Fort Henry's Muzzle-loader Roars to Salute a Kingston-to-the-U.S.-Corundum-Border Peace of For 55 Years

▲ Canadian Mounties Are Heroes to Farm Boys on the Ile d'Orléans

[illegible]

▼ "Brother Henri, Take Thine Hand Away!" Fresh Berries Lead to Temptation

[illegible]

Top-hatted Critics and Aristocratic Bonnie Clear of the Quebec's Carriage Trade

Parishioners Jog Homeward to Rocky Hillside Farms after Mass in Notre Dame du Portage

Togged in Sunday Best, a [illegible] Family Sets Out for Church

[illegible]

Pulp and Paper Students Grind Out Their Final Examination

[illegible]

Big, Busy and Cosmopolitan Montreal Is the Queen City of the St. Lawrence

Dredged Ship Channel Between Houston and Wells Bay, 50 Miles from the Sea

Lunch Calls Novice Fishermen Home after a Carefree Morning on the St. Lawrence

Every Day Looks Like Wednesday on the Road to Ste. Anne de Beaupré

Tongues Lolling, Sport and Bill Take a Well-earned Breather

Where Cod Is King, Fishermen Hand Down from Father to Son Their Skill in "Making Jobs"

Our liner then headed up the Saguenay into a setting sun. Sheer, glacier-gouged rock walls rose hundreds of feet. Beneath our keel black waters swirled to almost equal depths (page 348).

More than scenic is the Saguenay. Deep into the Quebec wilderness the river has thrust a salient of civilization.* On its incredible depths, nearly 1,000 feet, big ocean freighters push miles into the hinterland. Its narrow upper section, a torrent that drops 300 feet in 30 miles, generates more hydroelectric power than either Grand Coulee or Hoover Dam. With it, thriving Saguenay towns turn out vast quantities of newsprint and a quarter of the world's aluminum.

North Shore, however, passed the Saguenay with scarcely a sideward glance. Past towering headlands we steamed Quebecward. These dark Laurentian outposts were old-timers when the Himalayas were born. They end in frowning, 1,900-foot Cap Tourmente, which Champlain named for the tormented water swirling at its base. Here every spring and autumn migrating snow geese by the thousands make a St. Lawrence stopover.

On deck we watched entranced as these shadow-draped capes glided past in echelon. River-level towns, like Baie St. Paul, snuggled in tributary valleys; upland farms and villages sprawled high on sunny slopes. Connecting them, an adventuring road climbed and dipped.

Another day I rode that gravel roller coaster. It rose and fell so fast my ears kept popping. Changing, breath-taking scenes rewarded every climb—the broad St. Lawrence, Mediterranean blue; emerald-green islands; toylike ships far below; the dim south shore. Brief showers alternated with bright sunlight.

Many Have Scottish Name, French Tongue

At fashionable Murray Bay, "Newport of the North," I lunched in luxurious Manoir Richelieu, saw its remarkable collection of Canadian art, and browsed in the handicraft shops of Pointe au Pic (page 354). Champlain called this harbor La Malbaie, "the bad bay," because of its tricky currents.

The town retains the name, but the bay bears that of Gen. James Murray, one of Wolfe's aides. After the conquest disbanded regiments of Murray's Scottish Highlanders settled this shore and married French girls. Here live McTavishes, MacDonalds, Macgregors who speak no English.

Turning stern to the Laurentians, our ship headed into the deep south channel around big, pastoral Ile d'Orléans. Near the island's seaward end salt and fresh water meet in the fluid front line of a battle that daily swings to and fro, both eternal and new with every tide.

Here fresh and salty currents may flow side by side in opposite directions. Rock ledges between may have marine algae on one side, fresh-water flora on the other. Ocean fish sometimes follow saline paths deep into fresh-water precincts; drinking cattle watch porpoises play. Some towns find themselves on fresh water at low tide, on salt at high.

Storied Quebec, French Canada's Capital

Nearing Quebec, passengers crowded the rail to glimpse the historic rock-built city (page 329). After the lower river's open spaces, the channel's mile width seemed canal-like. Ahead a bend hid the city and seemed to close this water gateway to the west. Right here Cartier's heart must have sunk.

Slowly the roofs, spires, and battlements of French Canada's capital swung into view, and the gorgelike Quebec narrows opened. Climbing the slope of Cape Diamond, once the cornerstone of New France, the storied city stood out in bold relief.† A lowering sun bathed the town in mellow light and turned the windows of Lévis, across the river, to gold.

Few cities can boast such a spectacular site. The French, and later the British, made it the Gibraltar of America. For 150 years Quebec, high on her headland, defied her foes.

But the broad river proved an Achilles' heel. In 1759 British sea power brought besieging redcoats. Wolfe and his men climbed to glory on the Plains of Abraham, and Quebec fell. The next spring French forces defeated Murray at Ste. Foy, outside the city's gates, and laid siege to it. But when the ice went out, the river brought in British reinforcements.

Capt. James Cook, later of Pacific exploration fame, made the first real chart of the river up to Quebec. He was a young officer with the naval forces supporting Wolfe.

During the French regime, and far into the British, Quebec—then the head of ocean navigation—was Canada's emporium and chief port. With vast forests to draw on and the river to float them, she built sailing ships by the hundreds, and was long British America's leading timber port.

In 1825 she built the largest ship the world had seen, the 5,880-ton *Baron Renfrew*.

The era of wooden ships marked Quebec's great days as seaport and shipbuilder. Her square-rigged barks, brigs, and brigantines

* See "Canada Folk Settle Stern Saguenay," by Harrison Howell Walker, NATIONAL GEOGRAPHIC MAGAZINE, May, [illegible].

† See, in the NATIONAL GEOGRAPHIC MAGAZINE: "[illegible] in Northern Canada," by [illegible] C. Scott [illegible], February, [illegible]; and "Quebec, Capital of French Canada," by William Dow Boutwell, April, 1930.

A Cold and Lifeless St. Lawrence Yields a Glittering Winter Harvest

[illegible] These men work near Orléans [illegible]

sailed the world over. Her fast clippers clipped on sail in the race for China tea.

Steam, iron ships, and channel dredging moved deep-sea commerce 160 miles upriver to Montreal. Quebec still handles 2[illegible] tons of [illegible]

[illegible] Quebec I [illegible] of Lower Town [illegible] haunted the bustling [illegible]

[illegible] we bounced in [illegible] caleche over steep, cobbled, saint-named streets on a leisurely tour of Quebec-within-the-walls. At the doors of venerable institutions we left three centuries behind. For Quebec, despite the hurly-burly of modern traffic, its humming factories, smart shops, and neon signs, keeps a tang of [illegible]

A hospital dispenses mercy as it has since 16[illegible] [illegible] teaches [illegible] Monuments, bastered walls, old [illegible] their [illegible]

Island Farmers [illegible] Eels

With a French Canadian named MacKay I toured rustic Ile d'Orleans, island rock in the St. Lawrence [illegible] near Quebec.

Old Norman-type houses, facing the river, turned their backs to us. Wayside shrines (page 536) and steeple parish churches that are gems of early French architecture bordered our route. Lush crops and bursting barns indicated a good season. I saw many ox teams; [illegible] had a bright-red tractor.

Wooden Oxen and Settlers Clear Stumps from a Chiseled Wilderness

[illegible]

Montreal Presents a Gold-headed Cane to the First Skipper Running the Ice Blockade

[illegible]

Past Breeding Cliffs Through Norwaylike Fjords, the Seasons Leads to Giant Industries in the Quebec Wilderness

Truck Drivers Upset as Pulp Prices Soar as the Town of Kapuskasing Will Thrive with the Increased Capabilities of Leased Lines

True Son of the River Is the Gaspé Cod Fisherman

[illegible] Many [illegible] old men [illegible] with each house [illegible] Where [illegible]

At low tide I noticed tall [illegible] marking out tidal wire-and-wood "mazes" [illegible]

"Eel traps," said my guide. "Indians [illegible] with it the right to build a weir. You [illegible] them, head downriver for their ocean [illegible] ever catch them by the ton. Quebec each [illegible]

In a field we found a father and son mending a battered trap. Deft fingers wove spread wire into mesh. Wiggling his arm like an [illegible] the old man led us through the trap's maze. "A joke in French; I didn't get it."

"He says," MacGregor explained, "that's why we say 'pour fish'—they can get in but they can't figure the way out."

Returning along the island's south shore, we had a wide view of the rolling Quebec plain, spilling like a glacier between the city and towering Cap Tourmente. Ste. Anne de Beaupré, famous miracle shrine, stood out against the hills (page 360). Montmorency Falls poured a small cataract 100 feet higher than Niagara.

A hundred years ago Henry Thoreau, New England's [illegible] naturalist, hiked this [illegible] Thoreau fitted a comfortable tour from Boston, spent a week along the St. Lawrence. In *A Yankee in Canada* he extols the river's beauty and notes the trip cost him $12.75, including two guide books and a map.

Next morning, with a genial French Canadian, I crossed the river and headed east for the long, glorious road that rounds the Gaspé Peninsula, outthrust lower lip of the St. Lawrence's mouth.

Through [illegible] to St. Jean Port Joli. In this wood-carving [illegible] guild (page 347), master craftsmen [illegible] St. Lawrence schooner of sailing days.

[illegible] Massachusetts [illegible]

lem, Bic, was center for the far-ranging pilots of the lower river in the days of sail. Behind Ile du Bic they lay in wait; competing for jobs, they raced to incoming ships. Many a life was lost when sudden storms capsized them.

Now full-time pilots board vessels from the Government tug *Citadelle* off Father Point. Later I visited the pilot station and "walked the plank" at midnight in a misty rain between *Citadelle* and the Cunard liner *Franconia*, six days out of Liverpool.

Next morning on [illegible] I listened to landlubber passengers exclaim over Quebec's scenic approaches and caught the excitement of a transatlantic docking.

At Matane [illegible] we reached the real Gaspé, land of sea-washed hills and cove-set fishing hamlets, of hillside churches, wayside crosses, and covered bridges.*

The St. Lawrence north shore faded; only an occasional freighter, [illegible] plume, [illegible] the river's immensity (page 358).

A Retired Sailor Whittles Four-masted Barks Too Big for Bottles

Accident and illness [illegible] his job, made the fortune of [illegible] a former ship's [illegible] St. Jean Port Joli. Forced to change [illegible] While away long winter evenings, carved [illegible] now their orders keep [illegible] his wife, and 11 children [illegible] he gave up toy [illegible] to build real [illegible]

The Shickshock Mountains, part of the northern Appalachians, stamp the Gaspé's rugged character. Villages nearly three centuries old remain beachheads in a vast wilderness; civilization is [illegible]

Cod Is King in the Gaspé

Fishermen-farmers wrest small plots from reluctant hillsides, but their main harvest comes from the sea. Cod is king. Its symbols are everywhere—nets airing, fish drying (though much is now iced), fleets of boats strung along the coast, whole families cleaning fish (pages 325, 344, and 359).

Life along this rocky coast is full of hard, dangerous work; returns are meager. Land and sea are stern masters. Close to both, Gaspé people have a homespun quality, live humble lives.

A Sunday morning automobile accident showed National Geographic photographers B. Anthony Stewart and John Fletcher how Gaspé folk stand together. All parties escaped unhurt, but the photographers' car was battered. They estimated the damage at [illegible]

For help, the owner of the other car

*See "Gaspé Peninsula Wonderland," by Wilfrid Bovey, National Geographic, August, 19[illegible]

acknowledging God's responsibility, drove them to his village. Straight to the church he went, where Mass was just over. In a few minutes he raised the money. And on the Gaspé $250 is a lot sum!

Next day we drove to famed Percé, spent glorious hours there before returning to Quebec.

I rejoined a freshly painted *North Shore* for the 160-mile run to Montreal (page 324). Backing current and ebbing tide, she forced her way up the palisaded narrows. From top deck I watched historic places glide past—Wolfe's Cove; Sillery, site of the restored 1637 mission home of early Jesuits; the mouth of the Chaudière River, 1775 route of Benedict Arnold's "rabble in arms" on their way to storm Quebec; rocky Cap Rouge, site of Cartier's ill-fated winter quarters in 1542.

Beyond Quebec Bridge, one of the world's largest cantilevers, the river widened slowly and palisades began to lower. Through Richelieu Rapids, a swirling 6-knot current, we sailed a man-made channel linked by rocks exposed by the low tide. To navigate these "rapids," slow freighters await an incoming tide at Quebec.

Montreal a Man-made Seaport

Sand bars and rock shoals once choked this section of the river and limited Montreal-bound ships to 200 tons. In 1851 farseeing Montrealers began dredging operations to bring ocean traffic to their water front. Soon Quebec became a port with a past; Montreal a port with a future.

Over the years the man-made channel was deepened from 16 feet to its present 32½-foot minimum. Now dredgers seek 35 feet.

Veterans of far-flung sea lanes steam past grazing cattle and riverside farms to a world port 1,000 miles from the sea. They make Montreal's bustling water front look like a map of the United Nations. In one day I saw ships from Norway, Denmark, Great Britain, Italy, Latin America, Australia, and Turkey.

Some 135 veteran pilots man this stream of water-borne traffic. One group shuttles between Father Point and Quebec, another between Quebec and Montreal.

At least three years at sea and a long river apprenticeship lie behind each pilot. Handed down from father to son, piloting is a family affair often claiming three, four, or more brothers. When two pass on the river, it calls for much waving and long whistle blasts.

I watched our pilot work. Although the channel seemed as well marked as a superhighway, his eyes kept roving the shores.

"In the old days," he volunteered, "pilots steered by church steeples, big trees, any landmark. Now we line up our course by shore markers after every turn. We still use landmarks as a check, though. Notice how those twin steeples line up one behind the other."

Around sweeping bends he guided us. More than two miles wide, the river flowed majestically. Bluffs gave way to the flat, ever-widening St. Lawrence lowland, home of a fifth of Canada's people. Both shores seemed, as they did to 18th-century travelers, one continuous village.

This reach of the St. Lawrence is forever the river of New France. Place names—Vaudreuil, Sorel, Varennes, Champlain—honor its founders. The 60,000 French Canadians of 1760 now number some 3,500,000. More than half live within the sound of horned freighter whistles on the great river, still the broad "Main Street" of French Canada. To them, "Canada" means the age-old valley of the St. Lawrence.

Midway between Quebec and Montreal, at the swift St. Maurice River's triple mouth, smoking factory chimneys and mountains of stored pulpwood marked industrial Trois Rivières. Its colorful past spans 310 years, from fur post to capital of Canada's huge newsprint industry.

With Canadian friends I later visited this old-new, very French city. In the world's largest newsprint mill we saw logs ground or stewed to pulp. Flowing on endless wire screens over hot rollers, the wet pulp was transformed in 50 seconds into dry paper ready for tomorrow's headlines. In the town's papermaking school we saw the process again in miniature (page 340).

Near the water front we discovered a part of town that time forgot, where convent bells toll, and narrow, Old World streets resembled Quebec's.

The St. Maurice, Valley of Power

By car, canoe, and speedboat we explored the rugged St. Maurice Valley. The river's surging power, like the Saguenay's, has built new cities in the northern wilderness and made us build the world's largest newsprint center. High-tension wires, threading the valley, rush electric energy from five big powerhouses.

At La Tuque we saw men and machines changing the face of the land, building a giant dam to send power coursing to Sorel's new aluminum-smelting plant.

North Shore steamed across big, shallow Lake St. Peter, long the St. Lawrence's first barrier to ocean vessels. Here, when even his small pinnace grounded, Cartier took to an open boat. Until the channel was dredged,

French Canadians defending Quebec Heights

Need a Baby Sitter, Magicians, Bouncers? Moneymakers Club, McGill Students

Wonder Threads of Many Hues Keep Alive a Rural Scene

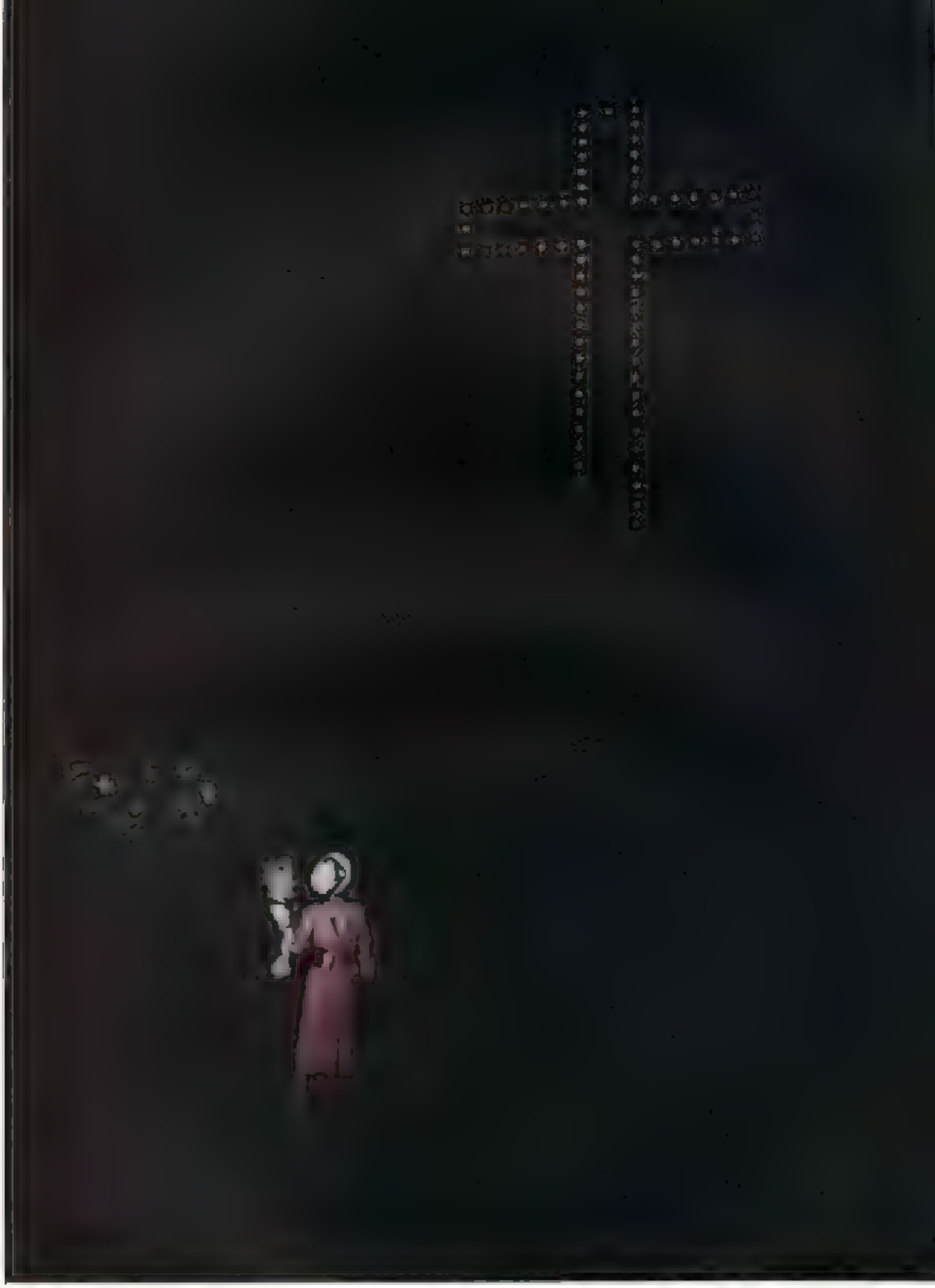
Tactical Visual Aids Have Cadets at Canada's West Point and Annapolis 'Sea' Cadets

▲ Godly French-Canadian Farmers Plant Crosses with Their Crops

[illegible]

▼ A Habitant Family Starts Chores Early on a Mass Morning

[illegible]



Electric Cross atop Mount Royal Reminds Canada's Largest City of Its Place Beyond

Cape Lights Sweeping a Scarlet Beam Warn Ships of Jagged Rocks Edge Deep Water

[illegible], *Empress of Canada* Swings Into the Current at Montreal

[illegible]

Work Seldom Finished, Gaspé Men Repair Nets [illegible]

[illegible]

Devout Pilgrims, Many Seeking Miracle Cures, Flock to Westernized Ste. Anne de Beaupré

Montreal-bound cargo was lightered from the lake.

Lake St. Peter swallows the tide. From a 12½-foot rise and fall at Quebec it dwindles to less than one foot at Trois Rivières and disappears in the Lake, more than 900 miles from the sea.

Flat shores and distant horizons hinted at the inland west; the wide sweep of water suggested the Great Lakes. Here, perhaps, the exploring Frenchmen got their first feel of America as a vast continent.

Through big, meadowlike islands, once a favorite Indian rendezvous, the channel zigzagged. Port side, Sorel's spires and shipyards marked the mouth of the Richelieu River, historic gateway to Lake Champlain and the Hudson Valley. Near by on the St. Lawrence shore, the town's new plant for smelting north-shore titanium took shape.

Several hours later we slipped past giant oil refineries and miles of docks, locked swiftly at Mary's Current under high Jacques Cartier Bridge, and tied up in Montreal.

In sailing days ox teams hauled ships up this strong current blocking the harbor. But in 1809 John Molson launched the *Accommodation*, the river's first steamboat.

Soon *Hercules*, a tug with a giant's strength in a dwarf's body, lifted the current's blockade forever.

In 1642, more than a century after Cartier's visit, a band of mystics under the Sieur de Maisonneuve founded a wilderness mission on the slopes of the long-dead volcano the explorer had named Mont Réal. For years the settlement lived a precarious life under repeated Indian attacks.

River-borne Trade Built Montreal

The tiny settlement's superb location for trade—at the foot of the thundering St. Lawrence rapids and the mouth of the mighty Ottawa River—could not long be denied. The rich fur trade, paddling the Ottawa, changed the mission into commercial Montreal.

In 1803 the growing town knocked down its walls and opened its harbor to world trade. The ship channel, begun in 1851, brought the sea to Montreal. Canals bypassing the rapids extended its commercial reach halfway across the continent.

Today this island city is Canada's largest, and its financial, industrial, and commercial heart. Its St. James Street is the Wall Street of Canada. Some 5,000 industrial establishments pour out two billion dollars' worth of varied products. The port, in seven and a half months, handles 21,000,000 tons of cargo.

Big, lusty, and cosmopolitan, Montreal impresses many a U. S. visitor as just another American metropolis. Tall buildings and traffic jams confirm their view. But with a longer stay the city's personality begins to reveal itself.

Two-thirds of Montreal's population of 1,383,600 is of French descent. Bilingual signs, such as *Pont Victoria Bridge*, are everywhere. Main streets, paralleling the river, become more French as they go northeast. Iron staircases climb the sides of many houses.

French restaurants serve excellent food in the continental manner. Narrow streets of the business district, corresponding to the old walled city, have a foreign look. Small squares bordered by limestone houses with fanlight doorways recall Edinburgh. The water front resembles a Clydeside port.

Mount Royal Commands a 60-mile View

Many points of interest spread from the 60-mile view at top Mount Royal down to the river (pages 340 and 341). But in a short stay the visitor can see famed McGill University (page 354) and the University of Montreal on the mountain slopes; Notre Dame, one of North America's largest cathedrals; and Château de Ramezay, headquarters of Continental troops that held the city for seven months during the American Revolution.

Here Gen. Richard Montgomery planned the attack on Quebec, after a committee composed of Benjamin Franklin, Samuel Chase, and Charles Carroll tried unsuccessfully to persuade French Canadians to join the Revolution.

The visitor can linger in the city's renowned botanical gardens; mix with crowds in colorful Bonsecours Market; see the old sailors' church with its ship models carved by grateful seamen; find remnants of a 17th century fort; enter smart shops and studios on Sherbrooke Street; and visit impressive St. Joseph's Oratory, miracle shrine second only to Ste. Anne de Beaupré.

With Maj. Guy Beaudet, assistant port manager, I covered Montreal's gray and grimy water front. Wearing slickers, we climbed towering grain elevators and followed conveyor belts carrying a golden stream from storage bin to ship's hold. On docks we watched locomotives being loaded for India, flour for Africa, horses for Trinidad's police, sugar unloaded from the West Indies, manufactured goods from Britain, and grain from canal-sized freighters.

"Montreal is the biggest transshipment point for western grain moving abroad," the Major explained. "We ship about 67,000,000 bushels

First Sign of Spring on the River—an Icebreaker Rips a Channel to Montreal

Chief cargoes are coal, wheat, gasoline, petroleum, and pulpwood.

This steady stream is almost all Canadian. Although Canada guarantees by treaty free use of the whole St. Lawrence to U. S. ships, only 41 used the canals in 1949.

To see the 182 miles of river between Montreal and Lake Ontario, I drove both shores and shot the rapids in *Rapids Prince* (p. 332).

Around sparkling Lake St. Louis, where tawny Ottawa River water and the blue St. Lawrence flow unmixed, I drove to the mouth of Soulanges Canal. Here ends a series of rapids that drop the river some 83 feet in 18 miles. Around them Royal Engineers built Canada's first canal in 1783. I watched while divers replaced a broken lock gate and impatient freighters waited in a long line.

Midway along the shore of big Lake St. Francis, French Quebec gives way to British Ontario. Many of its St. Lawrence towns were founded by Loyalists fleeing the American Revolution.

The tricolor and Quebec's fleur-de-lis flag disappeared; riverside Route 2 became the King's Highway.*

Some 25 miles later I looked across to an island farm flying the Stars and Stripes. Near industrial Cornwall, Ontario, the United States-Canadian border takes to the river and follows its channel to the Great Lakes. Here the north shore is Canada; the south, the United States. Islands a stone's throw apart may lie in different countries.

Seaway Considered Since 1895

More agitated than these troubled waters is the oft-recurring St. Lawrence Seaway and Power Project controversy. Broached periodically since 1895, this two-nation project calls for construction of the remaining links in a 27-foot navigation channel between Montreal and Lake Superior.

A proposed giant power dam would generate 2,200,000 horsepower, at Barnhart Island in the International Section.

"Operation St. Lawrence" entails the deepening of Lakes harbors and connecting rivers; the building of a control dam, the power dam, and by-passing locks in the Ontario-New York section; and improving the Soulanges and Lachine Canals in the Canadian sector.

Such a face lifting for the upper river could change Great Lakes ports into ocean ports and free big Lakes freighters to move downriver to Montreal, or to Seven Islands for Ungava iron ore.

Today generators tap the upper river for a million horsepower. But, completely harnessed, the mighty St. Lawrence could produce a staggering 5,400,000—half again as much as the combined output of Grand Coulee and Hoover Dams.

At a dozen places along the Canadian shore I watched the existing St. Lawrence waterway operate (page 330). Canal freighters squeezed into old locks with inches to spare. Lockkeepers turned hand cranks to open valves and gates. Such old-time methods pass some 4,000 ships a season.

On Sheek Island I had a water-level view of thundering Long Sault Rapids. Above Cardinal, where the locks end, the river broadened to some two miles and flowed as straight as a "canal" on Mars.

"Garden of the Great Spirit"

Crossing and recrossing the international border, I drove through miles of New Englandlike farm country and visited busy United States and Canadian river towns like Ogdensburg and Brockville. On both shores monuments recalled old wars on a border line undefended.

Finding the island-strewn St. Lawrence near Lake Ontario, an early French explorer exclaimed, "Les mille îles." And the Thousand Islands they became, though nearer 1,700 cut the river into countless winding channels and hide its broad expanse.

Indians called this land-and-water park Manitouana, "Garden of the Great Spirit." In its scenic maze warring British, French, and Indians played grim hide-and-seek.

Before the century's turn Americans bought islands, built summer homes, and made this a far-famed vacationland (pages 364 and 365).

By speedboat I saw the archipelago's haunting natural beauty. Mainland towns, swarming with vacationists, bore witness to its great attraction. Sight-seeing boats made their leisurely rounds; trim pleasure craft raced by. Amateur fishermen cast lines for speckled game fish. Music and laughter drifted from island lawns and swimming parties.

Recalling stark, frontierlike shores near the Gulf of St. Lawrence, I reflected how divergent are the extremes of this amazing river. Only occasional freighters tied them together.

Canada's West Point at Kingston

With brisk, 83-year-old Lt. Col. Courtlandt Strange I toured historic Kingston, Ontario, strategically set where lake and river meet.

*See, in the National Geographic Magazine: [illegible] by Bruce Hutchison, November 1947, and "Ontario, Next Door," by Frederick Simpich, August 1932.

Explorers Gazed Three-by-Three Thousand Islands. They Underestimated. There Are Lots

International Bridge Hopes Come True as Ice on Its 8½-mile St. Lawrence Crossing

Her Coat Choked with Ribbons, a Fox Farmer Hugs Her Quebec Snow Lutrs

[illegible]

Its long past holds memories of Count Frontenac, iron-willed Governor of New France, and La Salle [illegible] settlers and British [illegible] the Royal Navy on Lake Ontario; the beginnings of responsible government for Upper Canada; and the first meeting of a Parliament of the Province of Canada.

Today modern establishments carry on Kingston military traditions that go back 277 years. [illegible] stands the National Defense College. In 1876 the city's Royal Military College, the West Point of Canada, began life in "H.M.S. Stone Frigate," a former [illegible] storehouse. Here, too, is the Canadian Army Staff College.

Many [illegible] Kingston a [illegible] city and center of learning. Ivy-covered buildings of Queen's University, chartered by Victoria in 1841, [illegible] the shores of Lake Ontario (page 334). Industrious, the city has long made boats and locomotives. Now it also manufactures aluminum products and nylon in up-to-the-minute suburban factories.

High on the ramparts of old Fort Henry I watched the [illegible] A [illegible] cannon boomed (page 335), [illegible] proudly the Union Flag [illegible] Gliding [illegible] the island-studded [illegible] a freighter headed into the [illegible] of Lake Ontario. No wonder [illegible] told [illegible] he had [illegible]

"Delmarva," Gift of the Sea

By Catherine Bell Palmer

WATER-GIRT "Delmarva," anchored to the eastern coast of the United States by a 12-mile neck, is a unique peninsula, the only one in this country containing portions of three States—Delaware, Maryland, and Virginia.

Like some gigantic crooked finger, this out-of-the-way Peninsula points southward, separating Chesapeake Bay from Delaware Bay and the Atlantic Ocean.

From Wilmington, Delaware, at its first joint, south almost all of the 180 miles to its finger tip of Cape Charles, Virginia, this low-lying level land is threaded with twisting, turning tidal rivers from the Bay and with narrow inlets from the sea (map, page 371).

The unofficial but descriptive name "Delmarva" is in everyday usage on the Peninsula. At three approaches—south from Wilmington, north from Cape Charles, and east from Matapeake, Maryland—signs announce that each is the "Gateway to the Delmarva Peninsula."

Charters of English kings and acts of legislature decreed Delmarva's division. So bound together are its half-million people, however, that State boundary lines, long in dispute, now are practically forgotten.*

One sunny spring morning I drove a National Geographic car aboard the ferry at Sandy Point, Maryland. A short distance north of the ferry slip I could see men working on the new Chesapeake Bay Bridge. "Operation Link" they call the project because, when completed, the 4-mile bridge will link Maryland's eastern and western shores.

Brisk breezes chopped Chesapeake waters, sending us spanking across the broad Bay, second only to New York Harbor as busiest waterway in the eastern United States.

Kent Island Rich in History

On Kent Island, Maryland, site of the Eastern Shore end of the new bridge, a native shook his head slowly and complained that the span is "going to make it too easy for foreigners" from Washington and Baltimore to come over here."

During three centuries away from main routes of travel, Delmarvians developed a sense of independence. This spirit still stands out in the character of the people.

Many a time I had taken this route from Matapeake across Maryland's Eastern Shore to vacation at Rehoboth Beach, Delaware seashore resort. Then, in summer wind-whipped wheat fields were shimmering seas of gold. Mauve myrtle bushes bordered the road.

Now, as I drove along, farmers were plowing under crimson clover against green backdrops of loblolly pine. From a grove of gum trees came the bold declarative call of the cardinal, *right here, right here, right here.*

The humble setting of tiny Kent Island belies its great youth. Few motorists taking this route realize that the land was claimed for Virginia in 1631 by William Claiborne, then Secretary of the Colony of Virginia.

Armed with a trading license, Claiborne established a post here to trade with the Indians. When Charles I granted a charter later to the Calverts, Claiborne refused to recognize their jurisdiction over Kent Island. Tenaciously he fought for possession of his beloved island for years.

Chesapeake Bay Leads in Oystering

Near Kent Island Narrows, estuary that separates the island from the mainland, rose a huge pile of oyster shells. I wondered what the men hauling the shells into dingy white boats were going to do with them. One oysterman paused long enough to tell me. "Going down the Bay to plant cultch to catch spat."

Translated, that means putting oyster shells (cultch) on the bottom of Chesapeake Bay to provide a good resting place for infant oysters (spat).

When summer sun warms Bay waters, oysters begin to spawn. The average female American oyster can lay 16 million eggs, discharging them into the water, but it's pure accident whether they meet male sperm. Fortunately, millions of eggs sink to the bottom [illegible] seed. If all were fertilized and grew [illegible] would fill [illegible]

Continuous failure of natural oyster [illegible] of Chesapeake Bay, however, has caused a dearth of oysters. During the 1948–49 season, Virginia oystermen brought up more than 3,000,000 bushels from the Bay; Maryland, some 2,700,000 bushels. This sounds like a good catch until it is compared with the peak season of 1884–85, which for Maryland alone was 15,000,000 bushels.

In spite of the decline, however, Chesapeake Bay in 1949 gave up more oysters than any other body of water in the United States.

Virtually all of Maryland's oyster beds are owned by the State and are open to public reaping.

* See "A Maryland Pilgrimage," by Gilbert Grosvenor, National Geographic Magazine, February, 1937.

***Jay Dee*, Speedy Chesapeake Bay Log Canoe, Heads for Cambridge under a Cloud of Billowing Canvas**

[illegible]

[illegible] are caught [illegible] from [illegible]

[illegible] oysters were [illegible]

[illegible]

A [illegible] of the [illegible] one of the first regions in the United States [illegible] of British blood, shows that [illegible] of its 14 county names are English. The other two, Worcester [illegible] Maryland [illegible] and [illegible] are Indian [illegible].

[illegible]

[illegible] Virginia [illegible] Garden Week [illegible]

[illegible] warm weather [illegible] Garden Week [illegible]

Crushed Shells from This Oyster Mountain at Crisfield Make Hens Lay More Produce Stronger Eggshells

Cars Hitch a Ride on the Pennsylvania Railroad's Car Float Crossing Chesapeake Bay

Freight [illegible] travels by rail from New York, Philadelphia, and Wilmington to Cape Charles, Virginia. There the cars [illegible] make the trip to Little Creek, Virginia, in two hours [illegible] freight cars across the Bay.

[illegible] shortening, gave the cornbread its hickory-smoked taste.

When Mr. [illegible] mentioned the "provincialism" of the Eastern Shore, I asked him to explain. This was a term I had heard applied to the people here before.

"Self-sufficient, resisting change, set in their ways, I guess we'd call it," he replied. "But they are wonderful people, good friends, good neighbors."

Mrs. Bush said she heard many expressions [illegible] to her. [illegible] "It's a bad go, isn't it?"

When a house is dusty, it is "ashy"; a barnyard is a "pound"; pine needles are [illegible] and [illegible] properly [illegible] are "deadified" looking.

The next day I met National Geographic staff photographer Robert F. Sisson at Eastville, Virginia, seat of Northampton County. We spent hours in the tiny red-brick courthouse, delving into some of the oldest continuous county court records in the United States. They date from 1632.

We were looking [illegible] for the Northampton Protest. This document, dated March

PENNSYLVANIA

NEW JERSEY

MARYLAND

DELAWARE

VIRGINIA

Philadelphia

Camden

Wilmington

Baltimore

Washington

Annapolis

Dover

Atlantic City

Cape May

Salisbury

Ocean City

Bethany Beach

Rehoboth Beach

Lewes

Cape Henlopen

Newport News

Norfolk

Portsmouth

Alexandria

Chester

Woodbury

Camden

Trenton

Princess Anne

Onancock

Accomac

Wachapreague

Chincoteague

Wallops Island

Assateague

Ocean City

Fenwick Island

Selbyville

Millsboro

Georgetown

Milford

Harrington

Seaford

Laurel

Delmar

Berlin

Snow Hill

Pocomoke City

Crisfield

Somerset

Dorchester

Talbot

Caroline

Kent

Queen Anne's

Cecil

Harford

Baltimore

Howard

Montgomery

Prince Frederick

Calvert

St. Mary's

Charles

Anne Arundel

Prince George's

Frederick

Carroll

Baltimore

Harford

Cecil

Kent

New Castle

Sussex

Kent

Salem

Cumberland

Gloucester

Burlington

Mercer

Monmouth

Ocean

Atlantic

Cape May

Cumberland

Salem

Gloucester

Camden

Burlington

Ocean

Monmouth

Mercer

Middlesex

Somerset

Hunterdon

Warren

Sussex

Morris

Passaic

Bergen

Essex

Union

Hudson

Atlantic Surf and Two Broad Bays Wash Delaware's Shores

Delaware's Governor Knuckles Down to a Marble Game While Schoolboys Watch

Elbert N. Carvel, the Diamond State's 40-year-old Chief Executive, visits his son's public school in [illegible]

In 1682 [illegible] organized [illegible] first [illegible] in America. [illegible] devoted to [illegible] the Assembly [illegible].

About three miles from Eastville, on Old Town Neck, is Oak Grove Plantation, present home of Mr. and Mrs. Ralph C. Gifford, formerly of Louisville, Kentucky.

Mr. Gifford asked us if we had ever fished over [illegible] Gifford said. That's how I felt when some Eastern Shoremen invited me on such a fishing expedition.

"After a two-hour run [illegible] waters, [illegible]. Pointing to a spot on his chart, [illegible] fish over this track."

I looked over the captain's shoulder. It was a United States Coast and Geodetic Survey chart showing [illegible]

The next morning I drove south to Cape Charles on U.S. 13.

For 27 years the Virginia Ferry Corporation has operated ferries from Cape Charles to Little Creek, Virginia. During 1950 they transported more than a million and a quarter passengers and nearly half a million vehicles across Chesapeake Bay. Recently they started operating from a new terminal at Kiptopeke Beach.

Settlement Precedes Plymouth

Several years before the Pilgrims set foot on Plymouth Rock, 17 men went from Jamestown to the Eastern Shore to establish a saltworks. They settled along Old Plantation Creek, south of the town of Cape Charles.

[illegible] John Custis built [illegible] Arlington. [illegible]

Oxford, Maryland, Once a Thriving Port, Dozes Quietly Beside the Tred Avon River

[illegible]

Traditional tales about the colonel and his marital troubles tell of times when no word was spoken between him and his wife. But this [illegible] Custis, father-in-law of Martha Dandridge (later, Mrs. George Washington) had the last word. The inscription on his tombstone reads: "Aged 71 years and Yet Liv'd but Seven Years which was the space of time He kept a Batchelor's house at Arlington on the Eastern Shore of Virginia."

[illegible]

[illegible] Tomb [illegible]

[illegible]

In 1608, when Capt. John Smith and his 14 men explored Chesapeake Bay in an open barge of "two tunnes burthen," they reported they had never seen "better fish more plenty or variety, in any place." They tried catching them with a frying pan, but "found it a bad instrument to catch fish with."*

[illegible] rod and reel, however, a world's record 102-pound cobia (sergeant fish) was caught off Cape Charles, Virginia, in [illegible] record [illegible] channel bass catch, [illegible] pounds, was made off the same [illegible].

Clams Make Cherrystone Famous

Eastern Shore folk speak of the eastern and western [illegible] of [illegible] [illegible] waters of Chincoteague Bay [illegible] famed [illegible].

[illegible] Cherrystone [illegible] Cape Charles [illegible] gave the clam its name. I heard this story on the Eastern Shore, but the U. S. Fish and Wildlife Service says Cherrystone is a trade name denoting [illegible].

[illegible]

From Cambridge, Maryland, a Footwide Bridge Creeps Two Miles Across the Choptank River to Both Dorchester and Talbot Counties

A Lifeguard "Rescues" a Shark in Distress

[illegible]

Gay Plastic Handles Add "Eye Appeal" to Crisfield's Cleavers

[illegible]

Most of Delmarva Peninsula is a part of the Atlantic Coastal Plain of the United States, the emerged portion of the continental shelf.

Geologically speaking, the land is new—a mere 55 million years young. During these years the land rose from the sea and fell again at least half a dozen times. At the time of the last submergence, the ocean advanced across the continental shelf to a point far west of the present shore line, and the Susquehanna River found its way seaward through the Virginia capes.*

When the region finally sank to its present position, the restless sea took possession of the lower Susquehanna River Valley and transformed it into Chesapeake B[illegible]

During these geologic duckings, layers of sand, silt, clay, and gravel were deposited. So new is the land, however, that the material has not yet had time to turn to solid rock.

"Been plowing for 20 years and haven't struck a rock yet," one Worcester County, Maryland, farmer told me.

Proximity to the ocean promotes a long growing season, ranging from 155 days in the northern section to 220 in the south. An early spring and porous soil, permitting easy underground drainage, hasten maturity of vegetables and fruits (pages 370, 398, 399).

They warn a newcomer to the Peninsula when he sets out seed not to leave his fingers too long in the ground or they'll sprout!

The day I visited the John H. D[illegible] frozen food plant at Exmore, Virginia, spinach was being prepared for freezing.

Huge machines shook it free from dirt and from star grass and other weeds. The greens were washed five times to remove grit.

In gigantic pressure cookers called "blanchers," the spinach was precooked two minutes at 212° F. A conveyor belt moved the leafy vegetables along to the sorting table, where girls removed stems and cut out blemishes.

A Medley of Early Architecture

In the spring many of Maryland's pre-Revolutionary homes are open to the public. The twelfth annual pilgrimage was in full swing when I reached the Eastern Shore. Sponsored by the Federated Garden Clubs of Maryland, the tour included some 50 homes.

Rivers of the Eastern Shore were its highways in early days; so colonists, English planters, built homes near the water. Cutting into the level land, rivers have created a fantastic number of narrow necks. On almost every neck there is a house.

Architectural designs vary. Kent Fort Manor, in Queen Annes County, represents the small 17th-century one-and-a-half-story house. The "telescopic" type, each unit smaller than the other, is Kent County's Hinchingham. Characteristic of the five-part house, described locally as "big house, little house, colonnades, and kitchen," is Georgian colonial Wye House, on Wye River.

Salisbury's location near the center of the Peninsula makes it the metropolis of the Eastern Shore. The city is the converging point of two main Peninsula highways, east-west U. S. 50 and north-south U. S. 13.

Those who have business within an approximate 50-mile radius of Salisbury make its 150-room modern hotel their headquarters. It is also a popular stopover for motorists using the New York-Miami Ocean Highway.

I was startled at first when the desk clerk [illegible] me that the hotel had a "share-the-bath" [illegible]. To provide everyone with a private bath for at least part of his visit, each guest may have a room with bath for two consecutive nights only. Practically every day is moving day. One week I was shifted three times!

Chickens Plucked by Rubber Fingers

Within the past 25 years, the raising of broilers on Delmarva has jumped from a mere 1,000 birds in 1924 to 135 million in 1949, one-fourth the total of the United States.

Salisbury's large poultry-dressing plant can house 32,000 chickens. I think they were all there the day I was. Trucks loaded with crates of chickens were backed up to the receiving-room platform. Amid squawking and flapping of their wings, I shouted, "How many chickens can you handle in a day?"

[illegible] .000," the plant superintendent [illegible]. "It takes about a half hour to unload 3,000."

Chickens are kept from one to four days before being dressed, to calm their frayed nerves and to fatten them with a special mash.

I followed the whole dressing process, from throat slitting to the beheaded, detached, eviscerated broiler. Attached by the feet to overhead conveyors, the birds were dipped automatically in a tank of scalding water, then drawn through mechanical feather removers. Their rubber fingers of machines revolving at high speed beat off feathers.

After a dip in hot wax, chickens were immersed in a tank of cool water. When the hardened wax coat was removed, feathers which machines missed were embedded in [illegible]

Recently the Wicomico County Free Library, in Salisbury, acquired a bookmobile. Traveling 3,000 miles the first five-and-a-half

* [illegible] "Down the Susquehanna by Canoe," by [illegible] Gray, National Geographic Magazine, July, 1[illegible]

Under "Del-Mar-Va's" Finger, Dover Second-graders Read About Their Three-State Peninsula

[illegible]

Maryland Trappers Float Horse with a Good Day's Bag of Muskrats Soon to Become "Hudson Seal" and "Muskrat" Coats for Milady

They Wend Their Way Through 15 Acres of Pumpkins . . . She Picks Peppers for Pickling Near Dover

Young Dover Artists Sketch the Capitol of Delaware, the First State to Join the Union

[illegible]

Wye Oak, Big Enough to Shade a Hundred Picnickers, Was a Sapling When Henry VIII Ruled England and Red Men Owned America

Flashing Signal Light from the Lighthouse Guides 620 Planes to Safe Landing at Rehoboth Beach Airport . . . Red Means 'Stop Approach'

Stately Reed House, Ivy Covering Its Bricks, Preserves Colonial Traditions in New Castle

counties, it distributed some 7,000 books among rural schools and stations.

The library on wheels is popular with rural folk. "Book truck" they call it. A farmer's wife remarked, "Now we can see what we are paying taxes for."

I journeyed with the bookmobile to Tyaskin, Nanticoke, fishing villages. Business was slow that spring morning. Farmers were plowing. Oysters, ordinarily on hand to greet the bookmobile, were shucking oysters.

I was rowed over to a dock at Tyaskin, on the Nanticoke River. Beside his dog sat a shoreman mending a wooden basketlike affair, about the shape of a cucumber but larger. He explained it was an eel trap, with a plug at one end and a narrow opening at the other.

His was a typical shoreman's face, weathered by years of wind and sun. His deep-blue eyes crinkled at the corners when he squinted at me under the bright sunlight.

Chesapeake Bay Retriever, Native American Dog

"Isn't your dog a Chesapeake Bay retriever?" I asked.

"Yep," he nodded. "And her is a good one, too. Her is a better retriever than either of the two males I had afore her. When you can tarry a mite, I'll tell you a story. Set on yonder keg."

He had just bought the dog and was bringing her home in his boat across Nanticoke River one cold November day. Suddenly, out she jumped and started swimming away. He whistled and called, but on she went, paddling through icy waters. After a half-hour, when he was ready to give up, back she came with a duck between her jaws!

"I binged! Then I weren't proud of her," he mused. "Her was nothing but a puppy, and her had never see no duck afore!"

The Chesapeake Bay retriever is America's only native sporting dog.* No authentic record of its origin exists. Generally accepted legend is that the breed originated from two puppies, Canton and Sailor, aboard an English brig bound from Newfoundland and wrecked on the Maryland coast in 1807.

I struck up conversations with scores of shoremen and farmers, invariably, if our business at hand didn't require full attention, heard spin yarns as long as I'd listen.

Some 30 miles east of Salisbury is Maryland's only ocean port and largest seashore resort, Ocean City. Built on a barely quarter-mile-wide sandy strip, Ocean City is separated from the rest of Maryland by a narrow arm at the tip of Sinepuxent Bay.

I'd always been curious about the changing width of the beach at Ocean City. My mother visited there when she was a girl and told me about its wide beach. But when we spent a week at the resort in 1926, there was hardly any beach at all. Now here it was back again, as wide as she had described it.

An official of the Army Engineers' Beach Erosion Board explained that wave action, washing beach material away, probably accounted for the narrow beach of 1926. The hurricane of 1933 cut an inlet south of the boardwalk. Jetties were built to protect this inlet, which now gives entry from the ocean to commercial fishing trawlers. The jetties interrupt wave movement, giving the wide beach back to the resort.

Names of Berlin, Maryland, and of the Eastern Shore are old ones to me. In this town, birthplace of Stephen Decatur, American naval hero, my maternal grandfather was born. Although Grandfather left Berlin when he was young, an elderly doctor spoke of him as if he'd seen him yesterday.

I talked with distant relatives of mine who used a surname familiar to me since childhood. A poorly done piece of sewing looks as if it had been "sewed with a hot needle and a burning thread."

From Berlin I drove southwest to Crisfield. The road through the State forest to Pocomoke City is one of the most deserted on the Eastern Shore. Monotonous "thumpety-thumping" of tires over tar strips, glaring sun in eyes, a balmy breeze, and no sign of life forced me to sing to keep awake.

Salty Savor of Crisfield

At Crisfield, tracks of the Pennsylvania Railroad run down the middle of South Main Street to the water's edge. The water front with scores of oyster-shucking and crab-picking houses, oyster dredgers, skipjacks and bugeyes at anchor, crab floats, and mounds of oyster shells, gave Crisfield its salty savor.

As I walked down to one of the crab-picking houses, it was difficult to realize that the firm ground beneath me was man made—man made, that is, with the aid of millions of bushels of oyster shells.

I watched white-capped and white-aproned Negro women, seated at stainless-steel tubs, pick crabmeat from bright-red hard-boiled crabs. They were softly humming a spiritual to the rhythmic "tap-scrape" of knives (page 365)

Over at the crab pound, "peeler" crabs lay jostling one another, shedding their shells in

* See "Fish Dogs in Action," by Freeman Lloyd, National Geographic Magazine, January 1937

An Early Colonial Country Seat: Cedar Point Farm, near Easton, Maryland

[illegible] Mr. and Mrs. W. Alton Jones [illegible] The house's [illegible] [illegible] is reputed to be [illegible]

wooden floats stored in the water. At crab [illegible] been packed and exhausted [illegible] shells in wet seaweed for shipment.*

At Crisfield I met Lem Ward and his brother Steve, two old timers who hand carve and hand-paint wooden duck decoys.

Directions for finding their shop were confusing. No matter which way I went, I always ended up in front of the same general store.

Hollywood could have used the setting for a typical country store. Shelves bulged with canned vegetables. Counters were piled high with goods, from [illegible] to bobby pins and bubble gum. Around a [illegible] spittoon. A cat [illegible]

I asked the owner where I could find Lem Ward.

"Calculate he'd be a hard one to run into now. He's out asparagrassin'. Want to see him personal?"

I explained I was interested in duck decoys.

"His brother could help you. Hey, Steve," he [illegible] the group. "Lady to see you."

I [illegible] Steve over to his shop. [illegible] were stacked in the yard. He explained that [illegible] their ducks from the rafts' [illegible]

In the small shop, duck decoys were everywhere, piled high on shelves, scattered over

* [illegible] The National Geographic Magazine [illegible]

"Let's Duck the Champ" Is a Welcome Cry to the Winning Skipper

Gulping Juicy Mash, 11,000 Broilers Fatten in This Bridgeville, Delaware, Shed

[illegible]

[illegible] Bridge[illegible] page 584 [illegible]

[illegible] New England [illegible]

[illegible]

When [illegible] got out of the service after World War II, he was [illegible]

[illegible] Now he [illegible] running a farm [illegible] the ideal setup.

[illegible]

[illegible]

Delaware Preserves Its Colonial Charter in a Fireproof Vault at Dover

[illegible]

Lifelike Decoys Were Stool [illegible] "Newborn" Duck

[illegible]

Like a Giant Spider, Du Pont Spins Nylon by the Mile

[illegible] Delaware [illegible] nylon from coal, air, and water.

as aluminum wire the same size.

A [illegible] Henry Hudson [illegible] Capt. Samuel Argall [illegible] down off his course sailed into it [illegible]. He named [illegible] Lord De La Warr, [illegible] of Virginia [illegible] 1618.

The Dutch made the first settlement in Delaware in 1631 on the [illegible] Zwaanendael, Valley of Swans.

[illegible] walked along Pilot Town Road to Ship Carpenter Street [illegible] waters of [illegible] Delaware Bay pilot called it.

[illegible] Sussex County, I [illegible] States [illegible] of broilers. Of the [illegible] chickens raised in the [illegible]

lage of Seaford, Delaware, E. I. du Pont de Nemours & Company established in 1939 the world's first commercial nylon plant.

Nylon Transforms a Town

[illegible] Du Pont has transformed [illegible]. Former farmlands [illegible] plant [illegible] bank receipts have trebled.

Even after my two-hour tour of the plant, watching each step in the manufacture of nylon, it seems sheer wizardry to me that coal, air, and water, plus chemistry, can make a gossamer thread more than [illegible] than human hair, yet twice as strong

from Sussex County. Begun only 20 years ago, commercial broiler production [illegible] the State's most important source [illegible] (page [illegible]).

Delaware claims 29 of Delmarva's 47 hatcheries. From them some 119,030,000 baby chicks were shipped in 1948 (page 597).

At the John H. Mulholland plant in Milford, wooden [illegible] spools are cut out of veneer from gum logs.

One day a Mulholland official noticed a little boy with dirt-grimed fingers pull a

[illegible] National Geographic Magazine [illegible]

[illegible] National Geographic Magazine [illegible]

[illegible] wrapper [illegible] the largest [illegible] [illegible] [illegible] [illegible] Now [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] Dover [illegible] [illegible] called the [illegible] Methodism in America. [illegible] November [illegible] [illegible] [illegible] [illegible] for the first time in America [illegible] Methodist ministers.

Venerable Dover, Delaware's Capital

Driving into Dover I saw first the quiet [illegible] of the green [illegible] by tall [illegible] [illegible] houses which [illegible] when Delaware [illegible] the [illegible] [illegible] State. [illegible] Dover.

On [illegible] Delaware [illegible] [illegible] [illegible] [illegible] to join Washington's army, [illegible] townspeople of Dover assembled to listen to the reading of the Declaration of Independence and to burn King George's [illegible].

[illegible] of the green facing a [illegible] built the [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] Hall of Records [illegible] [illegible] [illegible] by Charles II to James, Duke of York, [illegible] Delaware counties. [illegible] one of the country's [illegible] [illegible] charters of the Thirteen [illegible] [illegible].

[illegible] Dover [illegible] [illegible] [illegible] [illegible] [illegible]

Virginia Game Wardens "Shoot the Breeze" While Reading Mail

[illegible]

[illegible] 1728 [illegible] [illegible] [illegible] the [illegible] [illegible] Gen. Anthony Wayne [illegible]

In the [illegible] of Christ Church [illegible] [illegible] monument [illegible] [illegible] [illegible] [illegible] Delaware [illegible] the Declaration.

Traveling [illegible] from Dover I [illegible] Delaware into Maryland. As I [illegible] [illegible] that [illegible] Chester River into Chestertown [illegible] the [illegible] [illegible] [illegible] [illegible] [illegible]

[illegible]

ant Protestant Episcopal Church. A tablet commemorates the adoption here in 1780 of the title, 'Protestant Episcopal Church' of the United States, as distinguished from the Church of England.

North of town I passed the rolling campus of Washington College, first in Maryland to receive a charter and only one to bear George Washington's name with his personal consent.

From Chestertown I headed east across the Peninsula, leaving narrower transverse roads for the broad Du Pont dual highway. So wide is this famous boulevard that exceeding the speed limit is not only a temptation but a fact. Here was the only time I ever saw anyone in a hurry on Delmarva.

When I asked a Delawarean why east-west roads in his State weren't as wide as the Du Pont Boulevard, he grinned and replied, 'Because no one wants to get out of Delaware!"

I found it difficult to drive anywhere on the Peninsula, particularly on back roads, without almost hitting many kinds of birds. Delmarva is in the Atlantic flyway, land bird and waterfowl migration route. Bombay Hook National Wildlife Refuge, some 14,000 acres of marshland along Delaware Bay, offers bed and board to migratory geese and ducks.

By placing freshwater pools within the marshlands, the refuge has attracted shovellers and gadwalls, species of duck, to nest near Atlantic tidewater. Particularly unusual is this nesting record for the gadwall, which normally makes its home in the north-central States and central Canada.

Nearly half of Delaware's 297,000 people live in Wilmington, at the head of the Peninsula. Although referred to as the northern gateway to the Peninsula, somehow this cosmopolitan industrial city seems far removed from agricultural Delmarva.

Between Wilmington and New Castle, near Harmburst, a sign marks the proposed approach to the new Delaware Memorial Bridge, to link Delaware and New Jersey shores.

New Castle Preserves Its Heritage

To the average motorist driving north on U. S. 13, New Castle, Delaware, means only the place to catch the ferry to Pennsville, New Jersey. Because the highway by-passes the quaint old town, motorists miss seeing a gem of surviving colonial architecture.

Unlike restored Williamsburg, Virginia,* many of New Castle's houses, preserving over 150 years of architecture of American, owned and lived in by town merchants,

* See "Williamsburg, Colonial Williams[illegible]

yers, and doctors. The "lived in" look of these colonial homes, with none of the stiffness of so many exhibit houses, gives old New Castle its individual charm.

The third Saturday in May each year, New Castle turns back pages of history, dresses in colonial costumes, and opens its lovely old homes and buildings to visitors (page 534).

When I arrived, "William Penn" and townsmen, in knee breeches, white stockings, and silver-buckled shoes, were strolling past the Old Court House, seat of New Castle County courts for two centuries. Long lines of visitors were waiting to lunch in the courtroom, where representatives of Lord Baltimore and William Penn struggled for Delaware territory.

On an autumn day in 1682, Penn first set foot on American soil here. From the Duke of York's agents he received the town and land within a 12-mile circle.

With 1,300 other people I watched folk dances on the green laid out by Peter Stuyvesant when New Castle was Dutch.

As I looked down Packet Alley to the river it took little imagination for me to visualize stagecoaches rumbling down this line, carrying famous men of their day—Daniel Webster, Henry Clay, Sam Houston, and others—to board packet boats for Philadelphia.

Proud of its heritage, New Castle plans further preservation where necessary. A recent survey, made by Williamsburg and Wilmington architects, revealed that, so carefully has New Castle preserved its buildings, some 70 percent need little alteration.

They Love Their Land

Traveling up and down this historic Peninsula, rambling back and forth from bayside to seaside, I was struck, as others have been, by the intensity with which its people love their land. To Delawareans, Marylanders, and Virginians alike on Delmarva, there just isn't any other place that can compare.

As I headed toward Washington, I shared a little of their feeling. I was sorry to leave this wind-swept land with its quiet villages, peaceful rivers, and easygoing way of life. The Eastern Shore, which had lured so many "foreigners" to buy or to build their homes on its shores, had once more cast its spell.

Leaving Delmarva by Maryland's Kent Island Ferry, I asked the pilot what he would do when the new bridge was built. He smiled.

"It won't make no difference to me, ma'am, 'cause I'm returnin' soon to the best spot in this whole wide world to live, the Eastern Shore. Got a place where I'm goin' to settle down to a little fishin' and a little farmin' and let the rest of the world go by!"

Maryland's Governor, William Preston Lane, Jr., and His Family Relax at Government House

Governor and Mrs. Lane and their daughter, Dorothy, are seated beneath a painting of Maryland's namesake, Queen Henrietta Maria, wife of Charles I of England. [illegible]

Skipjacks on the Chesapeake To Conserve Its Famous Oysters, Maryland Permits Only Sailing Craft to Dredge Commercial Beds

With Flying Fingers They Pluck Meat from Steamed Maryland Crabs

Home Folk Ride Free "Foreigners" Must Pay to Cross the Waters near Upper Bowie, Maryland

4-H Club Boys Candle Eggs, Looking for Telltale Shadows; Pullman Carries Peeping Baby Chicks to Delmarva Poultry Raisers

Hovering Only Four Feet Up, a Helicopter Sprays Concentrated Dust Death to Destroy an Entire Pepper Patch

They're 'Mapping the Universe,' but Dwarves' Secrets Hidden for Eons in the Sky

Mapping the Unknown Universe

By F. Barrows Colton

NIGHT was fast blotting out the landscape on the lonely summit of 6,000-foot Palomar Mountain, today's most famous outpost for exploring the Universe.

Only a ghostly wraith of light still hung in the western sky.

Standing beside me in the silent darkness, astronomer Albert G. Wilson was scanning the starry heavens with a practiced eye.

"What's your first target for tonight?" I asked.

"That patch of sky just east of the bowl of the Big Dipper," he said, pointing almost straight overhead. "As soon as the twilight's gone, we can get to work. The wind has died, and there's no haze. Tonight should give us good hunting!"

Mapping the Universe

We soon would be embarking on a night of exploring into the Unknown, deep into outer space, on one of the greatest projects of discovery in the history of astronomy.

This project is the making of the most stupendous map ever put together—a map of the Universe. Not all the Universe will be included, of course, for man may never be able to explore it all, but the map will show many times more of it than ever has been known before.

Made with telescopic photographs, the map will show for the first time almost all the heavenly bodies that exist in three-fourths of the sky, out to an average distance of 2,000 billion billion miles from the Earth. It will pick up objects so faint that their light takes 500 million years or more to reach us. And it will point the way for astronomers to explore still farther out into the even more remote regions beyond.

Survey Probes Unexplored Areas

Ancient and baffling riddles of astronomy will come nearer solution through new things the map will show. How big is the Universe? How [illegible] Is the whole Universe constructed like the small isolated samples that astronomers have explored so far?

The making of this map, known as the National Geographic Society–Palomar Observatory Sky Survey, is a joint undertaking of your Society and the California Institute of Technology.

Until now, telescopes could photograph no more than a tiny patch of sky at a time, so that only small scattered samples of Creation have been explored out to great distances. These samples have covered but one percent of the total area of the sky. But the Sky Survey will reach far out all over the heavens, covering vast areas previously unexplored.

Formerly, it was like trying to visualize the entire bottom of the ocean from a few widely spaced deep-sea soundings. The Sky Survey is equivalent to finding a way to see down through the water everywhere and chart accurately the whole ocean floor.

That night on Palomar we could see it rise on a near-by ridge the silvery dome of the famous new 200-inch Hale telescope, which can pick up objects so far away their light takes a billion years to reach us (pp. 405-9).

"Big Schmidt" New Kind of Telescope

But we ourselves would be working with the "Big Eye's" less-publicized but powerful partner, the "Big Schmidt," a new kind of telescope destined to equal if not surpass the fame of the 200-inch (page 404).

This is the telescope that is mapping the Universe. It is named for its inventor, Bernhard Schmidt, an eccentric German genius who devised a new system of optics of great benefit not only to astronomy but to television and X-ray work (page 417).

Actually the Big Schmidt telescope is a wide-angle camera. It is doing something that has been impossible until now—taking photographs of very large areas of the sky which are clear and sharp all over. Where the big Eye of the 200-inch "sees far," the Big Schmidt "sees wide." Although it can penetrate out into space only about one-third as far as the 200-inch, it can cover on a single photograph 500 times as great an area of the heavens.

In only four years the Big Schmidt will photograph all the sky visible from Palomar, three-quarters of all the heavens. For the 200-inch telescope to do this job would take 5,000 years!

The night sky is being photographed systematically in 935 sections on 14- by 14-inch plates. All the pictures will be published in a great Sky Atlas of 20 volumes, which President Lee A. DuBridge of Cal Tech says will be "an astronomical Bible for 100 years."

As we stood there in the darkness, the familiar Earth seemed unreal and far away. Above us the blazing stars, set like diamonds

Two Giant "Eyes" Gaze from Palomar's Top into the Uncharted Depths of Space

[illegible] dome in the foreground [illegible] but both houses the 200-inch Hale telescope, which [illegible] objects a billion light-years away, four million times farther than the faintest star the [illegible] can see. [illegible] Sky Survey is in progress. [illegible]

very close the Universe that stretched away all around us, out through the cold, awful depths of space."*

The Vast, Lonely Universe

Palomar's 200-inch telescope can reach out and isolate a spherical section of this Universe [illegible] that first, traveling [illegible] miles a second, takes two billion years to cross it. Astronomers measure it with a giant yard-stick, the light-year, the distance light travels in a year, which is nearly six million million miles.

Scattered far and wide through this vast, [illegible] like lonely islands in a limitless [illegible] are estimated to be more than [illegible] tremendous formations of stars [illegible] called nebulæ, or galaxies. Most of them are flat and round like a wheel [illegible] with arms spiraling out as from a Fourth-of-July pinwheel. Some are globular or oval (p. 410).

One of these systems is what [illegible] Milky Way Galaxy, our home in [illegible] countless other galaxies, it is roughly [illegible] with outward spiraling pinwheel [illegible] are perhaps 5,000 million stars, [illegible]

* See "News of the Universe" by F. Hart [illegible] Carnegie Institution's Mount Wilson [illegible]

Engineers at the Lowell Study Near Heavenly Bodies Revealed by the Sky Survey

Ready for Action, the Big Schmidt Telescope Points at a Target in Outer Space

Already new heavenly bodies of all kinds, in vast profusion, are being discovered on the Sky Survey photographs.

On some single pictures taken with the Big Schmidt appear as many as 15,000 to 20,000 huge galaxies of stars out in space beyond the Milky Way. Each one of these galaxies is an isolated island in the Universe, containing hundreds of millions of stars (page 410).

Clusters of galaxies, rarely seen until now, are showing up on almost all the pictures, one plate alone shows 17 clusters, almost as many as all previous telescopes had found.

Dwarf galaxies, too, containing only a few million instead of hundreds of millions of stars, are being found in far larger numbers than ever had been observed before.

New "Neighbors" of Milky Way

Two new "neighbors" of the Milky Way Galaxy, small elliptical-shaped galaxies, have been found on the Schmidt plates. One is the smallest galaxy ever found, only 1,500 light-years in diameter. These galaxies, some 650,000 light-years from us, are near enough so that more than 200 of the brightest stars in each of them can be distinguished.

In our own Milky Way Galaxy the Sky Survey pictures are expected to reveal more of the mysterious novae, or exploding stars, which suddenly flare up to hundreds of millions of times their former brightness in a few hours or days.

They are called novae (Latin for "new") because old-time astronomers, seeing them suddenly appear where no star had been noticed before, thought they were new stars. Supernovae are as much as 10,000 times brighter than ordinary novae.

In the Milky Way, too, the Survey is revealing huge glowing clouds of gas, and is recording for the first time, all on one picture, the over-all extent of gigantic dark clouds of dust and gas that are so big they formerly could be photographed only piecemeal.

New members of the solar system, the little asteroids, or subplanets, that circle around the Sun, are being picked up by the score.

Astronomers used to think these asteroids might be fragments of an old planet that once had owned an orbit between Mars and Jupiter, and later broke up, because most of them circled the Sun between these two planets. But now, with asteroids showing up all over the solar system, this idea may have to be changed. Instead, perhaps, these little bodies may be debris left over from some ancient catastrophe in which the planets were created, or old comets that have lost their tails.

Two new comets have been found by the Survey, one of which speeds in near the Sun and out again into space on a circuit that takes only two-and-a-third years. The other is now moving toward the Sun, and will come closest to it in January, 1951.

Trail Blazer for the 200-Inch

Already, too, the Big Schmidt is performing its intended task as trail blazer for the 200-inch telescope, pointing the way for the Big Eye to explore still farther out.

Until now, the 200-inch and other big telescopes could only grope more or less blindly out into space, hoping to pick up distant galaxies here and there. But the Schmidt's wide-angle pictures are showing the Big Eye where to look (pages 414, 415).

Though the most distant galaxies that the Big Schmidt can pick up barely show as pinpricks on the photographs, their exact positions in the sky can be determined. Then the big telescope can be trained on them without delay, to photograph them on a larger scale.

Already the 200-inch telescope is photographing such newly found galaxies as a step toward solving one great puzzle of the Universe—whether it is expanding at breakneck speed like a gigantic soap bubble. Distant galaxies found in the past all show the famous "red shift," a reddening of their light which indicates they are rushing away from the Earth and from each other at almost unbelievable velocity, thousands of miles per second, like the fragments of a bursting bomb.

Is this happening everywhere in the Universe? Are all the galaxies speeding outward, or are some standing still, or even rushing back toward us? Now the astronomers expect to find the answer, for on the Survey pictures they can select distant galaxies distributed uniformly all over the sky and see if all of them show the tell-tale red shift.

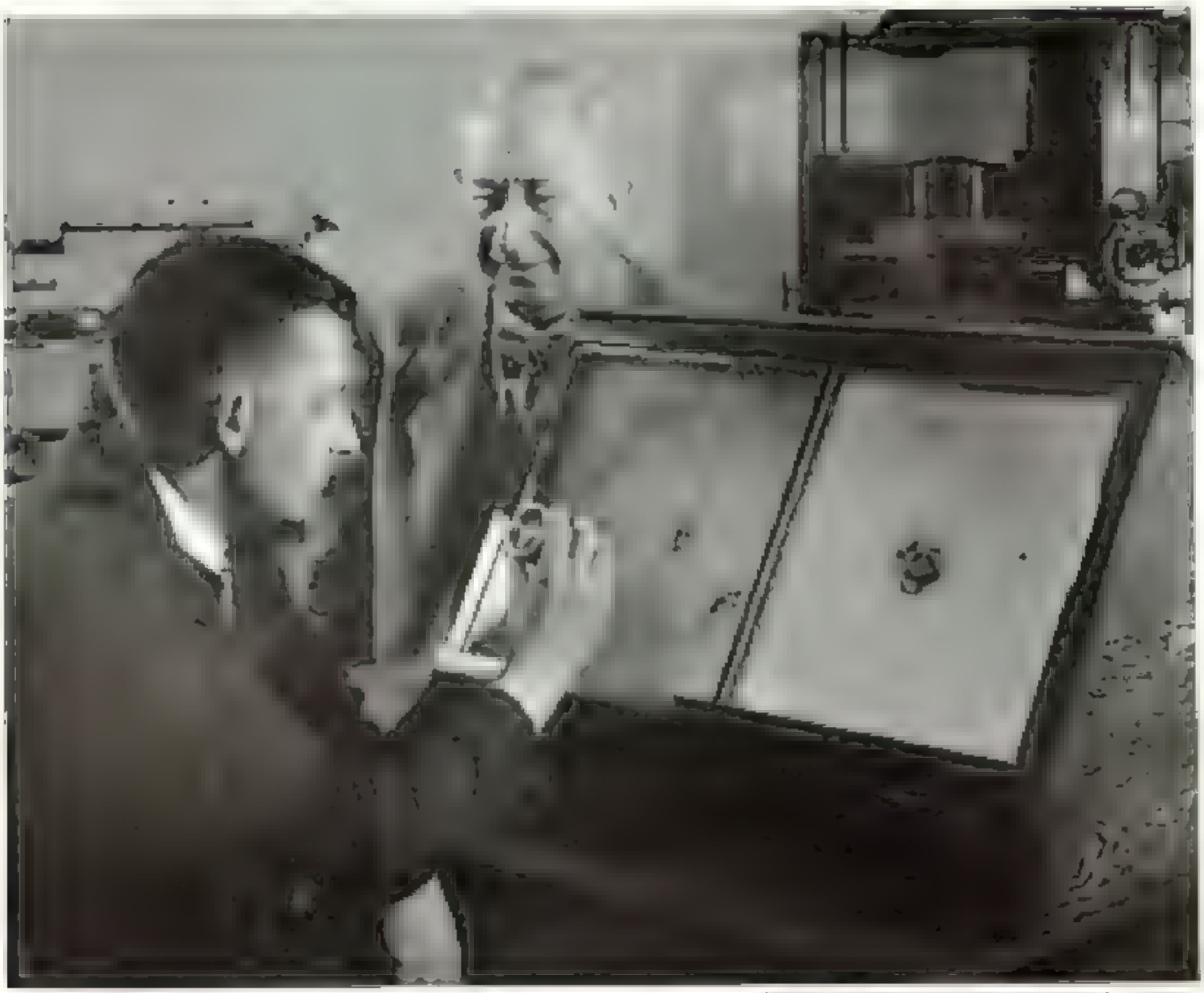
Exploring in Space and Time

Where to search still farther out in space, for galaxies too faint to be registered by the Schmidt telescope, will be indicated indirectly by the Survey pictures. Where the photographs show galaxies to be concentrated out as far as the Schmidt can penetrate, the chances are good that the bigger telescopes will find even fainter ones beyond. And the clearest "windows" in the sky also will be revealed, areas where no clouds of dust or gas obscure the view.

Watching the Big Schmidt and the Big Eye in action through the long night hours, you sense the dramatic and quiet excitement and marvel at the precision that goes into the exploration of the sky.

First of 1,870 Photographs for the Monumental Sky Atlas Shows the North America Nebula

[illegible]



What Startling New Discoveries in the Sky Will This Newest Plate Reveal?

The camera is now the most valuable instrument used in astronomy. Here Professor Max Wolf, of Heidelberg, is shown at the telescope which he has devised to photograph the heavens. By this method thousands of stars and nebulæ are recorded on a single plate.

Professor Barnard, Director of the Yerkes Observatory, Chicago, is also engaged on photographic work of the highest importance.

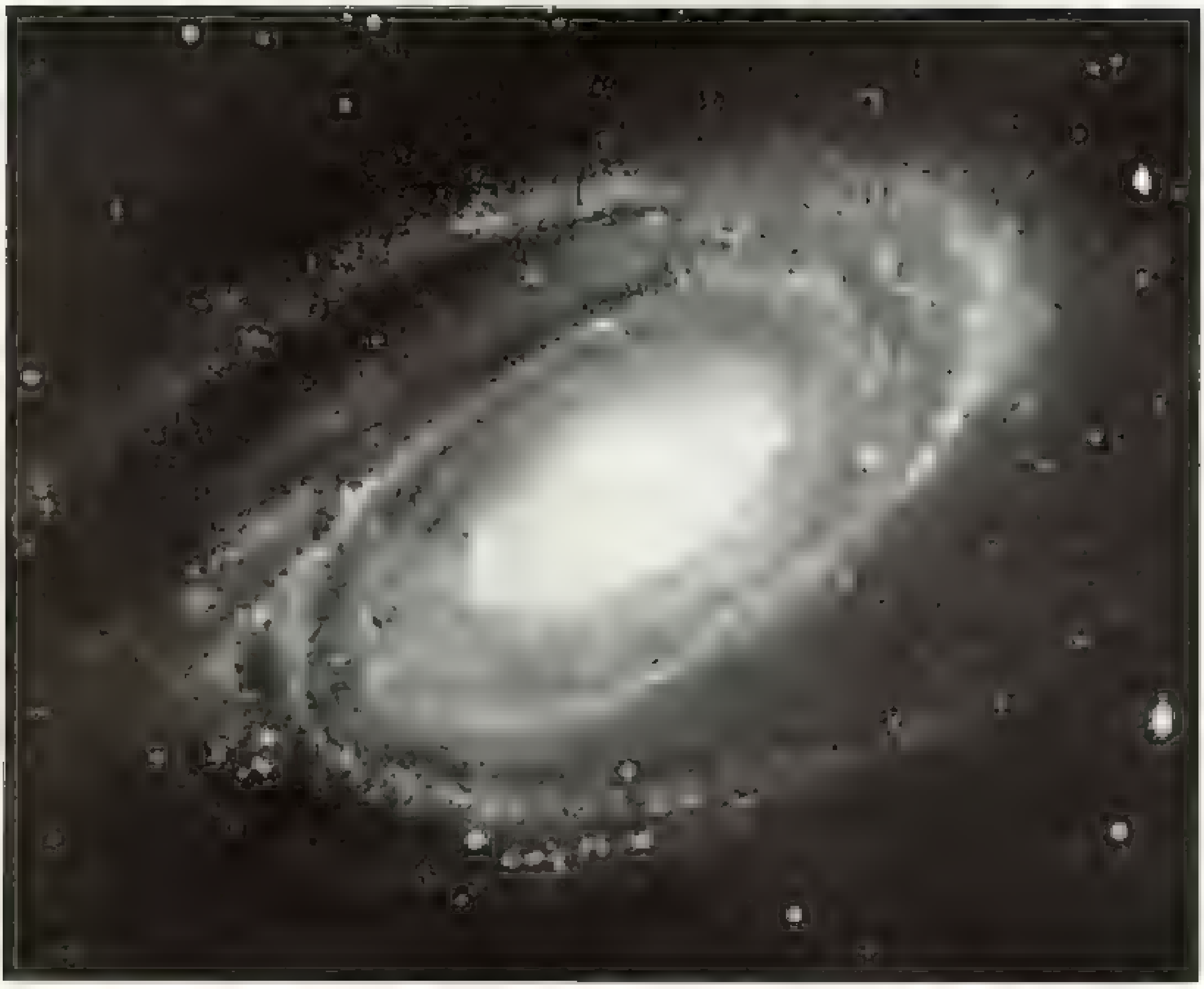
And Sir David Gill, the astronomer royal at the Cape of Good Hope, has been using photography to map the southern skies.

Astronomers have thus become the most enthusiastic photographers in the world, and their telescopes are being built with the object of penetrating deeper into the mysteries of the universe than ever before.

Professor Sir Norman Lockyer

Who has done much to popularize astronomy, and whose new book, "The Sun's Place in Nature," is attracting much attention.

Largest Ever Built, Palomar's 200-inch Telescope Dwarfs 300 Astronomers Meeting Beneath It



Millions of Stars Make Up This Spiral Galaxy, Typical of Countless Others

[illegible]

[illegible] water mains and hydrants ready to keep [illegible]

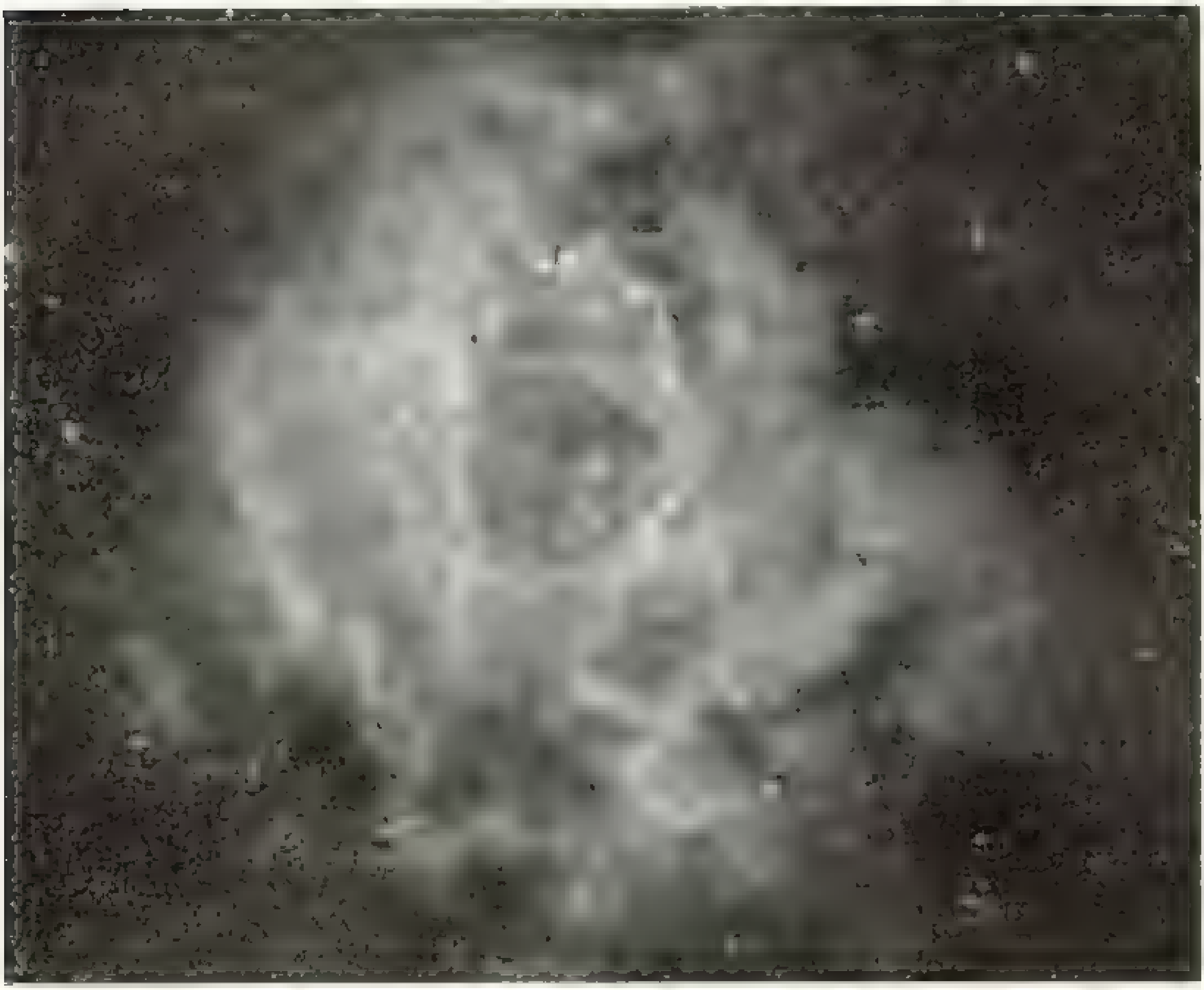
[illegible]

Big Schmidt in Action

[illegible]

As soon as the first photographic plate was placed in the telescope [illegible]

[illegible]



Rosette Nebula Is a Huge Shining Cloud of Dust and Gas in the Milky Way

[illegible] in the cloud which glow from the heat of [illegible] stars. It also [illegible]. Some astronomers think such clouds may be the raw material from [illegible] or the remains of stars that have disintegrated. This object is [illegible] light-years [illegible] in diameter. It is located in the constellation of Monoceros, the Unicorn.

[illegible]

Dome Turns Automatically

[illegible]

[illegible] in space.

The only [illegible] the telescope's driving motor [illegible] correcting lenses. [illegible] was turning automatically to keep [illegible] in line with the moving telescope [illegible].

[illegible]

[illegible] photographed [illegible] plates, one sensitive to red light, the other to blue. [illegible]

[illegible] are [illegible] scores of times as hot as the sun. Comparing the brightness of stars shown on both plates reveals their color.

Dawn Is Bedtime for Astronomers

[illegible]

which gives an indication of their temperature, and this in turn is an important clue to their life history.

Red light also penetrates better through the dark clouds of dust and gas that hide or dim the light of many stars in the Milky Way, helping to reveal what lies concealed [illegible] these gigantic curtains.

Big Eye Takes a Long Look

Next night I watched the [illegible] Big Eye turn its more powerful gaze on some far-off galaxies that the Big Schmidt had discovered only a few nights before. Dr. Milton L. [illegible], veteran ex[illegible] showed me a [illegible] taken by the Big Schmidt [illegible]. Under a [illegible] their outlines were [illegible] which showed [illegible] which have [illegible] sharp images.

Humason was to [illegible] galaxies [illegible] would photograph the spectrum of their light. If it showed the red shift [illegible] it would indicate the galaxies were rushing away into space at terrific speed.

These galaxies were so far away that their light, arriving at Palomar that night, had started on its journey [illegible] years before. It had been speeding [illegible] before the human race [illegible] since the time when the first fishes were [illegible].

The pictures Humason would take would show these galaxies as they were in that remote past. What they are like today no one can know. Perhaps they have sped billions of miles farther off into space; perhaps they are coming back toward us again; possibly they have changed their forms entirely or even no longer exist at all.

Observer Rides in Telescope

In the small open elevator we rode up [illegible] So large is the telescope that the [illegible] in [illegible] diameter [illegible] Here [illegible]

Giant Mirror of Palomar's 200-inch Telescope Is Carefully Checked for Flaws

Investigating Mars' "Canals"

This Picture and Opposite One Show How the Screen Trade Targets for the "Big Time"

Seen with the "Big Eye," Core Nebula Resembles a Comet Leaving Wake of Black Dust

undisturbed

New Holidays for Astronomers

when they aren't working they climb

When the Lesson Is Astronomy, Palomar Pupils Should Know All the Answers!

The story of the Big Schmidt telescope, even of the Sky Survey itself, one might say, began with a small boy rubbing the bottom of a broken bottle in a saucer of fine sand in an obscure Estonian island village in the Baltic Sea, some 50 years ago.

With these ingredients young Bernhard Schmidt was grinding a lens for a camera made from a cigar box, and getting interested in the science of optics. The son of a German father and a Swedish mother, the boy had first been interested in explosives, but a crude homemade bomb blew off one of his arms. This accident was fortunate for science, for it turned young Schmidt's attention to the less dangerous business of experimenting with cameras, lenses, and mirrors.

Solving an Ancient Problem

Schmidt settled in Germany, grinding mirrors for astronomical telescopes. An eccentric, solitary figure, he always worked in formal costume of cutaway coat and striped trousers, chain-smoking big cigars. He disliked regular hours, but finally consented to take a job with the Hamburg Observatory at Bergedorf because the director would permit him to work pretty much as he pleased.

For years he struggled to solve a problem that had plagued astronomers ever since they started photographing the heavens. In their pictures only the center was clear and sharp; images of stars outward toward the edge were distorted because of unavoidable defects in the way light is reflected from the mirror onto the photographic plate.

In 1929, while Schmidt was on the way to the Philippines to observe an eclipse of the Sun, the solution dawned upon him. Later he built a small telescope on the new model, trained it upon a distant quarry, and invited his friend, Dr. Walter Baade, now on Palomar's staff, to take a look.

"Can you read the names on the tombstones?" Schmidt asked.

"Yes," was Baade's elated reply, "and I can see only one thing—the optics are absolutely marvelous!"

Schmidt's system provides a thin glass correcting lens in the upper end of the telescope, through which the light of celestial bodies passes before it falls upon the mirror at the bottom of the tube. The mirror, instead of being curved like the surface of a sphere, dips down into a concave hollow all around, then rises again at the edge. Light rays passing through the lens are bent in such a way that when they fall upon the mirror they are reflected onto the photographic plate in perfect focus all over its surface.

The mirror is ground into a spherical curve, rather than the parabolic curve used in most telescopes, and the photographic plate is bent into the same spherical curve as that of the mirror. This helps produce photographs that cover a wide area and are clear and sharp all the way out to the edge.

U. S. astronomers saw at once that Schmidt had solved a long vexing problem. The first Schmidt telescope put into professional use was an 18-inch constructed for Palomar in the Cal Tech shop at Pasadena. The phenomenal success of this instrument inspired the construction of a still larger one, the 48-inch, which would act as an auxiliary for the 200-inch Hale.

Today's Big Schmidt, with a 48-inch lens placed in front of a 72-inch mirror, not only "sees wide" but can gather enough light to pick up very distant bodies as well, an ideal combination for mapping the heavens. Its speed of f/2.5 makes it extremely fast.

Schmidt's system is also used today in projection-type television sets to make all possible use of the available light in forming a clear image on large screens.

Some of the X-ray machines used in mass tuberculosis surveys employ the Schmidt system to produce clear photographs on small film, replacing expensive large glass plates. Though other scientists came close to developing the optical system designed by Schmidt, none carried it quite as near perfection as he.

Plates Kept in Special Vault

More precious even than the Big Schmidt itself will be the 1,870 glass plates on which it is recording the map of the Universe.

In a vault three stories below ground, beneath a building that is proof against fire and earthquake, on the campus of California Institute of Technology, the priceless plates will be carefully guarded. As an extra precaution, a set of duplicate positives will be made also on glass.

Enlargements on film will be made as well, and from these in turn will be made negative prints, showing the heavenly bodies as dark images against a light-gray background. Astronomers prefer such prints for study, because the size and brightness of objects can be measured more accurately when they are dark on a light field.

Negative prints like these will be used for the actual pages of the Sky Atlas containing all the pictures taken in the Sky Survey. If engravings were used to reproduce the Survey pictures, much of their fine detail would be lost.

Most of the actual discoveries in the Sky Survey are made not on Palomar itself but

Bernhard Schmidt Found a New Way to Map the Universe

[illegible]

the Milky Way Galaxy from a distance, over-all, it would be easy to understand its structure," Dr. Rudolph Minkowski told me. "But we have to look at it from the inside, like an ant trapped within a big cheese sandwich [illegible]

[illegible]

[illegible] Our nearest neighbor spiral-type galaxy, the Andromeda [illegible], is built this way. We can look out and see the galaxy's overall [illegible]

"The [illegible] plates will show which stars are the hot blue type [illegible] a more accurate picture [illegible] in or near one of them.

in the laboratories in Pasadena, where the astronomers study the photographs [illegible] with high-precision instruments (page 4??). [illegible] distances and [illegible] in [illegible].

Our Galaxy Has Spiral Arms

All this will provide a far better understanding both of how our own Milky Way Galaxy [illegible] and of the structure [illegible]

If we could travel out [illegible] space and see

The Milky Way Galaxy [illegible] like a [illegible] trated that [illegible] patch in the [illegible] curtain of dark dust and [illegible] rifts in this curtain through which parts of the "hub" can be photographed and explored.

Why and how often do stars [illegible] denly flaring up into a vastly [illegible]

Looking down the Big Schmidt's Throat Shows Arrangement of Its Lens and Mirror

Don Hendrix, Palomar optician, is reflected [illegible] peers down in the 72-inch mirror at the rear [illegible]. [illegible] holder is the square object between the [illegible] is reflected [illegible]

ness? Do stars [illegible] types of galaxies [illegible]? What [illegible] condition of a star [illegible] Sky Survey will [illegible] answers [illegible].

Clues to Star Explosions

About two dozen exploding stars show up each year in our nearest neighbor spiral galaxy, the Andromeda nebula. What [illegible] of a nova's flare-up may be a true explosion of the star or perhaps a nuclear chain reaction like that in the atomic bomb.

Hereafter when astronomers spot a nova they can refer back to the Survey photographs [illegible] when the star was [illegible] before it blew up. The pictures will reveal its original color, temperature and brightness, which may furnish clues to the cause of the cataclysm.

Nearly 25 million galaxies, or nebulae, are scattered through outer space within range of the Big Schmidt's eye, it is estimated by Dr. Edwin P. Hubble, who has studied them for [illegible] years.

[illegible] galaxies may go through a [illegible] of evolution [illegible] gas to an oval formation [illegible] spiral [illegible] with stars appearing [illegible]

Enough samples of all kinds of galaxies should show up on the Survey plates to indicate whether this theory is correct, or whether

the galaxies begin and end their lives in some other way.

"We'll see in the Survey pictures a far more complete and accurate sample of the Universe than ever has been available before," Dr. Hubble told me. "It will give us a far sounder basis on which to judge what the rest of the Universe is like. But, of course, if the Universe is infinite in size, even this sample will be insignificant."

Galaxies May Decrease Far Out

There's some indication, Dr. Hubble says, that the number of galaxies begins to drop off at a distance of about 500 million light-years from the Earth, judging from pictures previously taken with the 100-inch telescope at Palomar's sister observatory Mount Wilson, near Pasadena.

That may mean the Universe is finite, or limited in size; or merely that the number of galaxies decreases at one point, then increases again farther out. The 200-inch telescope, penetrating twice as far as the 100-inch, should give the answer.

Some scientists believe all the matter in the Universe once was concentrated in a huge primordial "atom," which exploded into fragments consisting of the millions of galaxies that we see today still flying off into space.

Another theory is that the explosion filled all space with gas and dust, which gradually condensed to form the galaxies, and that the stars were formed in turn by further condensation of the gas within each galaxy, a process still going on.*

The only real evidence that the Universe is expanding is the red shift of light from the outer galaxies. According to the laws of physics, this means the galaxies are rushing away; yet it's possible, says Dr. Hubble, that the red shift in this case is caused by some law of Nature unknown to us and means something else entirely.

"Why is all this important? Why study astronomy, why map the Universe, when most of it is so infinitely far removed from human affairs?" I asked Dr. Ira S. Bowen, director of both Palomar and Mount Wilson Observatories (page 413).

"Well," he said, "I might ask you, why study geography? Astronomy is really an extension of geography. Exploring the Earth, people were never satisfied until they found what lay over the next hill. Now that man has charted most of the surface of his own planet, he wants to know what lies beyond, out in space. Curiosity will never let him rest until he solves the riddles of the Universe.

"How old is the Universe and how did it begin? People used to think our own Earth had existed only a few thousand years. Now we know that it and the rest of Creation date back two or three billion years. How it all began is still a mystery, but maybe sometime we'll get at least part of the answer, and mapping the sky will help.

Man's Place in the Universe

"Man's place in the Universe is another riddle. The ancients believed that the Earth was the center of everything, with the Sun and stars revolving around it. Then it was found that the Earth and other planets revolved around the Sun. Next we discovered that the stars were much farther away than anyone had realized, and our horizons expanded again.

"Until only about 25 years ago, most astronomers thought that the outer galaxies were comparatively small objects inside the Milky Way. But with the big new telescopes we found that these galaxies were of enormous size, as big as the Milky Way itself, and were scattered out through space at distances no one had ever imagined.

"Each step seemingly has further reduced man's relative importance in the universal scheme of things, but still his mind can reach out and at least partially explore and understand the immensity around him."

Not all astronomers are religious men; yet when the Palomar Observatory was dedicated the program bore on its final page these well-known words from the Eighth Psalm:

> When I consider thy heavens, the work of thy fingers, the moon and the stars, which thou hast ordained;
> What is man, that thou art mindful of him?

* For additional [illegible] National Geographic Magazine [illegible] 1899-1946," especially "[illegible]eavens Above [illegible]" H. Menzel, July, 1943.

Notice of change of address for your National Geographic Magazine *should be* [illegible] *sure to include your postal-zone number.*

NATIONAL GEOGRAPHIC SOCIETY

GEOGRAPHIC ADMINISTRATION BUILDING

SIXTEENTH AND M STREETS NORTHWEST, WASHINGTON 6, D. C.

ORGANIZED FOR "THE INCREASE AND DIFFUSION OF GEOGRAPHIC KNOWLEDGE"

To carry out the purposes for which it was founded [illegible] years ago the National Geographic Society publishes this Magazine [illegible]. All receipts are invested in The Magazine itself or expended directly to promote geographic knowledge.

Articles and photographs are desired. For material The Magazine uses, generous remuneration is made.

In addition to the editorial and photographic surveys [illegible] being made. The Society has sponsored more than 100 scientific expeditions, some of which required years of field work to achieve their objectives.

The Society's notable expeditions have pushed back the historic horizons of the southwestern United States to a period nearly eight centuries before Columbus crossed the Atlantic. By dating the ruins of the vast communal dwellings in that region, The Society's researches solved secrets that had puzzled historians for three hundred years.

In Mexico, The Society and the Smithsonian Institution, January 16, 1939, discovered the oldest work of man in the Americas for which we have a date. This slab of stone is engraved in Mayan characters with a date which means November 4, 291 B. C. (Spinden Correlation). It antedates by 200 years anything heretofore dated in America, and reveals a great center of early American [illegible].

On November 11, 1935, in a flight sponsored jointly by the National Geographic Society and the U. S. Army Air Corps, the world's largest [illegible] ascended to the world altitude record of 72,395 feet. Capt. Albert W. Stevens and Capt. Orvil A. Anderson took aloft in the gondola nearly a ton of scientific instruments, and [illegible] results of extraordinary value.

The National Geographic Society–U. S. Army Air Forces Expedition, from a camp in southern Brazil, photographed and observed the solar eclipse of 1947. This was the seventh expedition of The Society to observe a total eclipse of the sun.

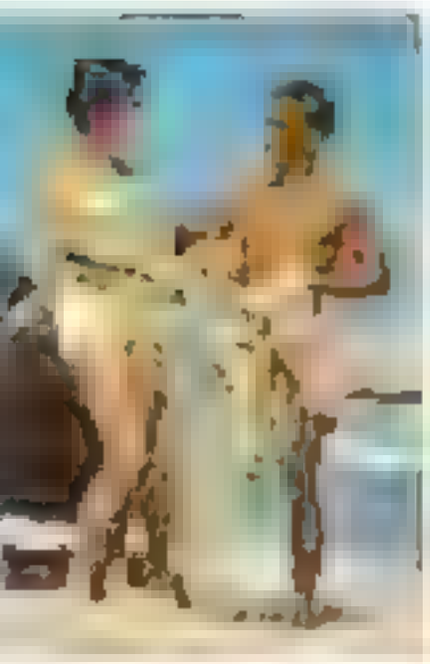
The Society cooperated with Dr. William Beebe in [illegible] record depth of 3,028 feet was attained.

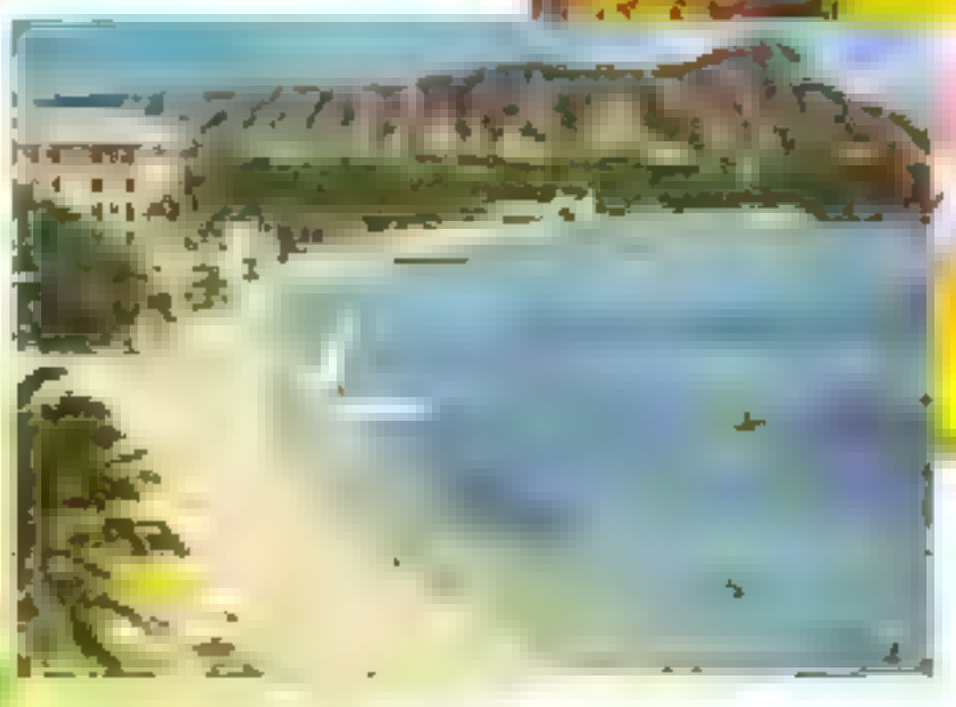
The Society granted $25,000, and in addition $75,000 was given by individual members, to the Government when the congressional appropriation for the purpose was insufficient, and the finest of the giant sequoia trees [illegible].

[illegible] of the world's [illegible] Bradford Washburn [illegible] Society and the Harvard Institute [illegible].

So excitingly different . . .

A South Sea Autumn Vacation in *Hawaii*





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The man who put up a monument to 15 minutes

George Carlson [illegible] every time he walks into his [illegible] looks at his fine, new furniture. The [illegible] on Mr. Carlson's monument [illegible] "To the most valuable fifteen minutes I ever spent."

Mr. Carlson shivers every time he [illegible] he might have missed [illegible] those fifteen minutes. He could have been [illegible] could have seen "red" [illegible] refused to listen when an Agent of one of the North America Companies explained how woefully weak Mr. Carlson's property [illegible] really was.

Mr. Carlson did none of these things. Instead, he listened carefully to the Agent's [illegible] examination of his insurance coverage.

So, when fire destroyed his home, Mr. Carlson had the *right* insurance in the *right* amount to replace everything.

[illegible] valuable fifteen minutes may [illegible] when you talk with an Agent [illegible] of the North America Companies. You'll [illegible] competent, straightforward advice on *all* [illegible]

You'll see for yourself how little it will cost to buy the best protection, tailored to your own needs. And you'll be comforted by [illegible] that your insurance will be placed [illegible] oldest, strongest, and most [illegible] in the business.

[illegible] the North America Companies [illegible]?

Insurance Company of North America, founded 1792 in Independence Hall, is the oldest American stock fire and marine insurance company. It heads the "North America" Companies which meet the public demand for practically all types of Fire, Marine and Casualty insurance, including Automobile, Accident, Aviation and Liability insurance; Fidelity and Surety Bonds. Sold only through Agents or Brokers.

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Full sculptured in "Third Dimension Beauty," [illegible] pattern.

And [illegible]
[illegible]
[illegible]
[illegible]

The majestic shell, the [illegible] wave, the [illegible] and the sparkling bubbles complete the imaginative accomplishment.

"Romance of the Sea" is [illegible] fine sterling silver [illegible]. Also Mr. Warren's Grande Baroque, Sir Christopher, Grand Colonial, Stradivari and Rose Point. Prices [illegible]

WILLIAM S. WARREN

[illegible]

Do you count your daily cups of coffee?

Most folks do keep track of how much coffee they drink.

It's because they have [illegible] of this delicious beverage.

For they realize that coffee contains caffein and that caffein can make some people nervous and irritable, keep them awake at night.

Whenever you are tense, jittery, sleepless, you naturally wonder if coffee is the cause. Should you cut down on the number of cups you have each day? Should you cut it out altogether? Here's what to do!

DRINK SANKA COFFEE

REAL COFFEE—97% CAFFEIN-FREE

You can go right on drinking the coffee you love so much—as much as you want with Sanka Coffee!

Sanka Coffee is caffein-free!

Sanka Coffee won't make you jittery—or keep you awake. It just can't—because 97% of the caffein has been taken out.

But removing the caffein doesn't subtract a bit from Sanka's rich, full-bodied flavor—its tempting aroma. You still get the wonderful taste-goodness—the wonderful sense of satisfaction and bracing cheer that only coffee can give you!

Start drinking Sanka tomorrow. [illegible] coffee—[illegible] to lose, and possibly a great deal to gain.

Sanka Coffee

Real coffee with the worry taken out. Drink it and sleep!

Products of General Foods

Welcome Aboard The New Sunset Limited

The Sunset Limited, Southern Pacific's [illegible] between New Orleans and Los Angeles, [illegible] equipped with new Budd all-stainless steel cars. There [illegible] these [illegible] together to provide daily service [illegible] terminal. And they are [illegible].

[illegible] the [illegible] of the [illegible] bayous [illegible] to the [illegible] desert [illegible]. The [illegible] pioneer coaches [illegible] the [illegible] coffee shop-lounge cars [illegible] Sunset Limited personify the southwest.

Along with [illegible] stainless steel construction [illegible] to provide the greater safety [illegible] Budd railway disc brakes. Stops [illegible] effortless [illegible] imperceptible.

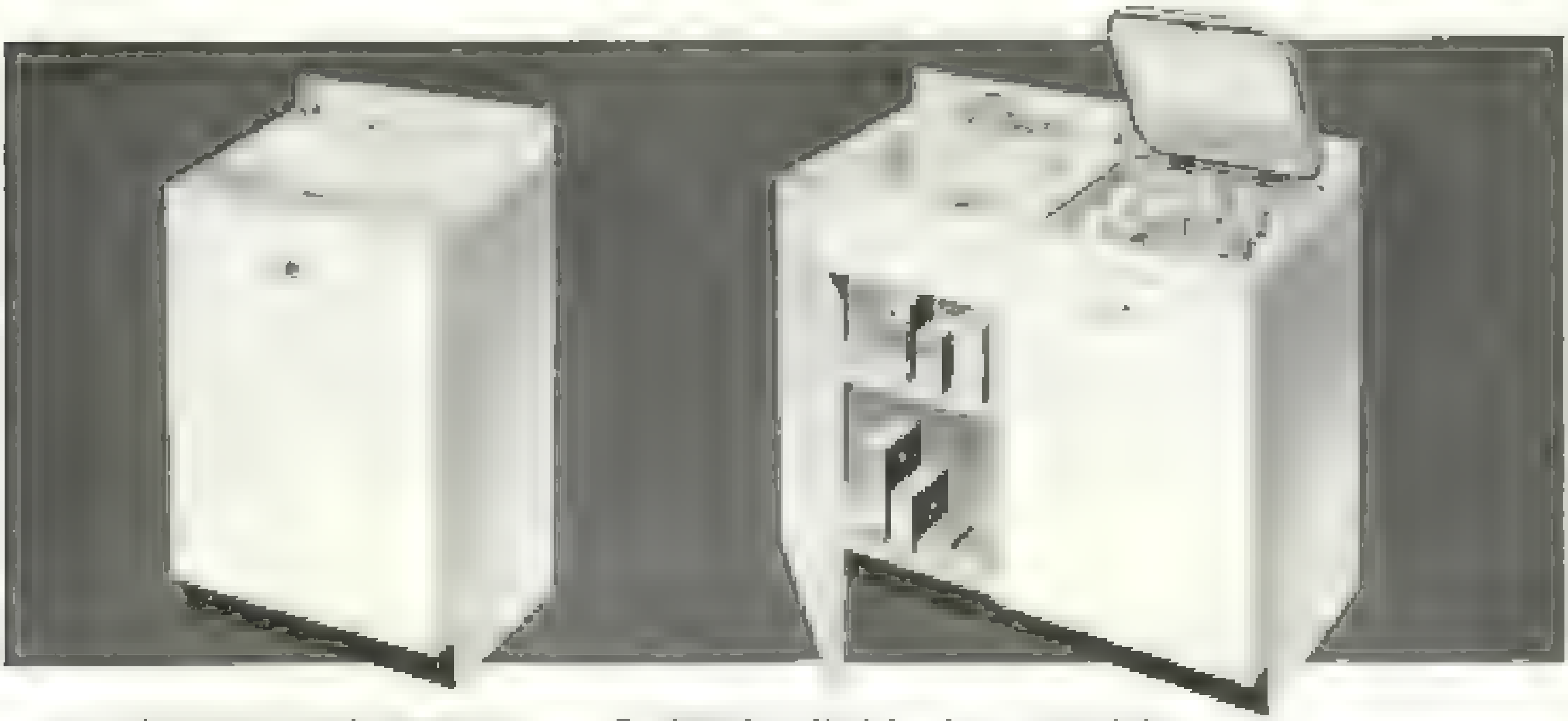
The Sunset Limited [illegible] Budd Company's most recent contribution to railway progress. They give you a new and compelling reason to experience the pleasure [illegible] by train. The Budd Company, Philadelphia, Detroit.

Budd

It's new—really new! No other dishwasher can match it!

With this great new G-E Automatic Dishwasher

...your hands need never touch dishwater again!



Free-Standing Model— [illegible]

Combination Model— Automatic dishwasher built in with G-E Electric Sink.

[illegible]

This great new General Electric Automatic Dishwasher will do the whole job for you [illegible]

[illegible]

Just look at all these worksaving, timesaving G-E features

- **Completely Automatic**—Just turn one simple control!
- **New Preliminary Power Rinse**—[illegible]
- **"Spray-Rub" Washing Action**—[illegible]
- **Higher Water Temperatures**—[illegible]
- **Drying by Heated Air**—[illegible]
- **Top Opening**—[illegible]
- **Giant Capacity**—[illegible]
- **Saves You More Than 200 Hours**—[illegible]
- **Long-lasting Dependability**—[illegible] long years of [illegible]

FREE DEMONSTRATION

[illegible]

Low down payment! Easy terms!

You can put your confidence in—

GENERAL ELECTRIC

Mention the National Geographic—It identifies you

CHOOSE THE RIGHT POINT FOR THE WAY YOU WRITE

ONLY A FEW OF THE MOST POPULAR POINTS SHOWN

Esterbrook

FOUNTAIN PENS

Remember this point. Whether you write at home at business, or at school—the best fountain pen for you is an Esterbrook. That's because an Esterbrook Fountain Pen offers you the world's largest variety of point styles. You select the point that suits you best—the point made for your kind of writing—and fit it into the barrel yourself.

In case of damage, all points are instantly replaceable, promptly from dealer without sending your pen to a repair shop or back to the factory. All pen counters sell Esterbrook pens for [illegible]

MATCHED PEN AND PENCIL SETS $4 to $8.50

High above 5th Avenue
SINCLAIR
Searches for Oil

This map room is GHQ in Sinclair's search for oil. It organizes the information Sinclair's top production planners need to direct drilling and exploration.

To this map room come reports from Sinclair scouts and exploration parties. Here is recorded the location of every well of all Sinclair geophysical and geological surveys and of acreage owned or leased by the Company. Essential facts are plotted by specialists on three wall maps—maps so large that unrolled and placed end to end they would exceed the length of a football field. Supplementing them is a file of almost 1,000 detailed logs of wells.

In the next five years Sinclair will be engaged in an intensive program to increase production of crude oil. This map room will be a particularly busy place during that time—another reason why Sinclair is . . .

"A Great Name in Oil"

SINCLAIR—
A Great Name in Oil

SINCLAIR OIL
CORPORATION
630 Fifth Avenue · New York 20, N.Y.

Visit the Sinclair exhibit at the Coliseum—it's worthwhile

Bob Hope says...

"Thanks for the DC-6!"

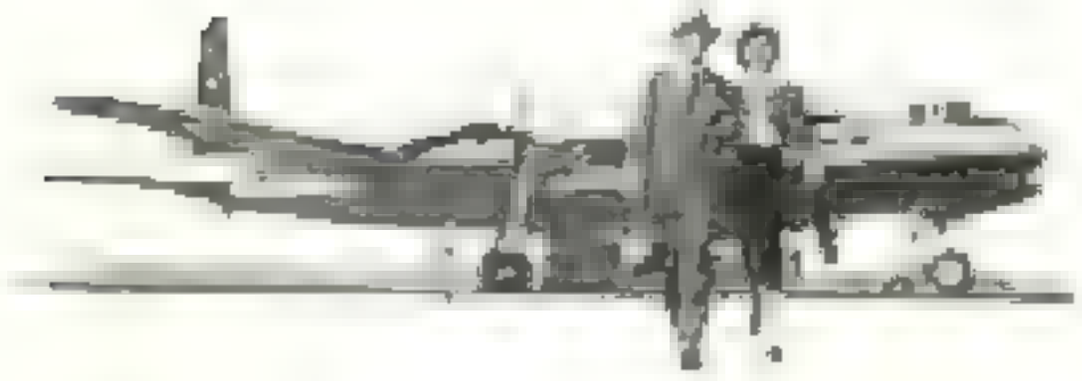
BOB HOPE starring in "FANCY PANTS"

a Paramount picture Color by Technicolor.

One of America's most famous flying ambassadors, Bob has flown millions of miles in Douglas airplanes, says nothing beats the DC-6 for speed and downright flying comfort!

• New York...London...Paris...Rio...Honolulu—wherever in the world you want to fly—there's a giant, four-engine Douglas DC-6 waiting to serve you. You'll find no better, more luxurious or dependable way to travel. That's why more experienced air travelers—people who know airplanes—style they prefer the DC-6. And every time you step aboard a Douglas airplane you have the comforting thought that Douglas has built more transports ...which have flown more miles of dependable service... than any other aircraft manufacturer in the world. Ask your travel or airline office for reservations aboard the Douglas DC-6 —the blue-ribbon luxury sky liner of leading airlines everywhere!

Twice as many experienced air travelers say the Douglas DC-6 is the luxury transport they like best!*



* According to a recent nation-wide survey.

DOUGLAS AIRCRAFT COMPANY, INC.
SANTA MONICA, CALIFORNIA

30TH ANNIVERSARY YEAR

Do You Use Lots of *Envelopes?*

Standard Package

[illegible]

$1.00

Deluxe Package

[illegible]

$2.00

[illegible] $1.00

[illegible]

AMERICAN STATIONERY

THE FINE STATIONERY IN THE PLAIN BOX

THE AMERICAN STATIONERY COMPANY
840 PARK AVENUE, PERU, INDIANA

Mention the National Geographic—It identifies you

The REVERE by Du Mont
17-inch Rectangular [illegible]
[illegible]

You always wanted a Du Mont.
Now here they are— bigger, newer, better than ever
and at prices that make news!

HERE COME THE NEW DU MONTS

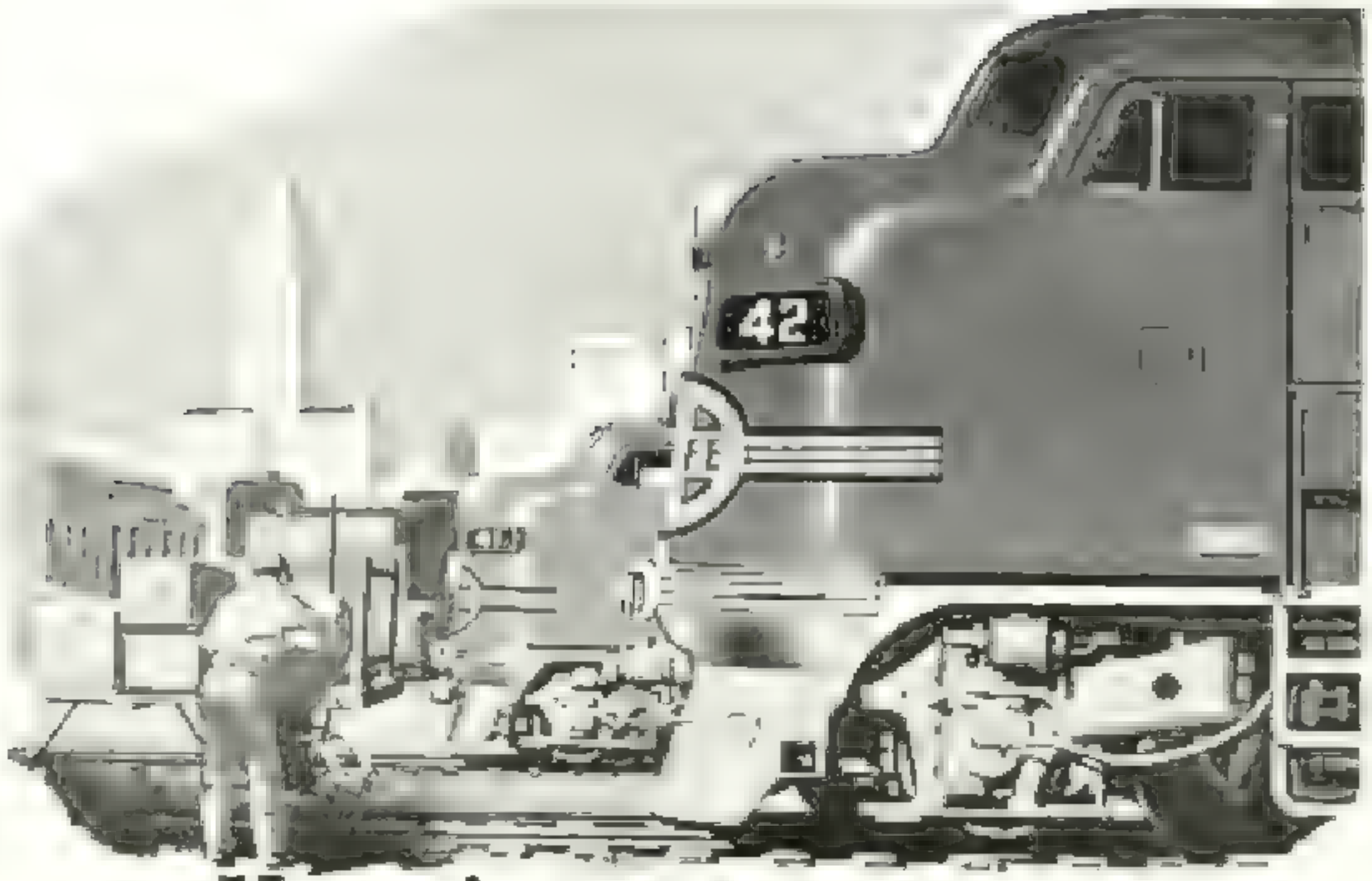
The TARRYTOWN by Du Mont
[illegible] Automatic Phonograph.

These are Television's finest instruments. Every one of the sixteen new Du Monts has the famous engineering of the laboratories that built the first home television receivers. More than ever, a Du Mont is the greatest value in television.

The ARDMORE by Du Mont
17-Inch Life-Size Picture
Built-In FM Radio
Plug-In for Record Player

Buy with confidence from your Authorized Du Mont dealer

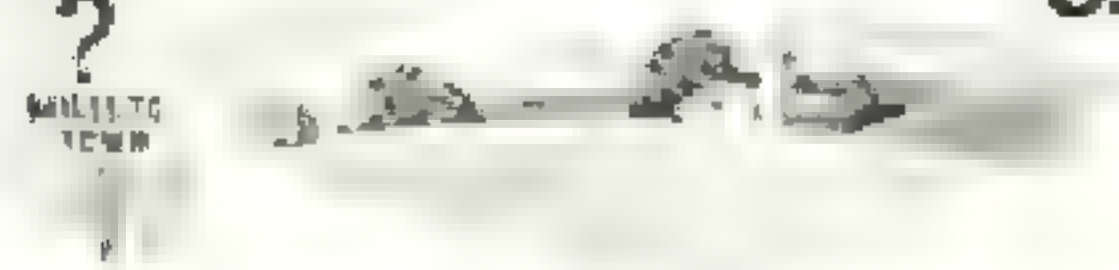
DUMONT



You arrive and depart

Down-Town

on the SantaFe



– not out in the country

Ride great trains through a great country

Colorful New World

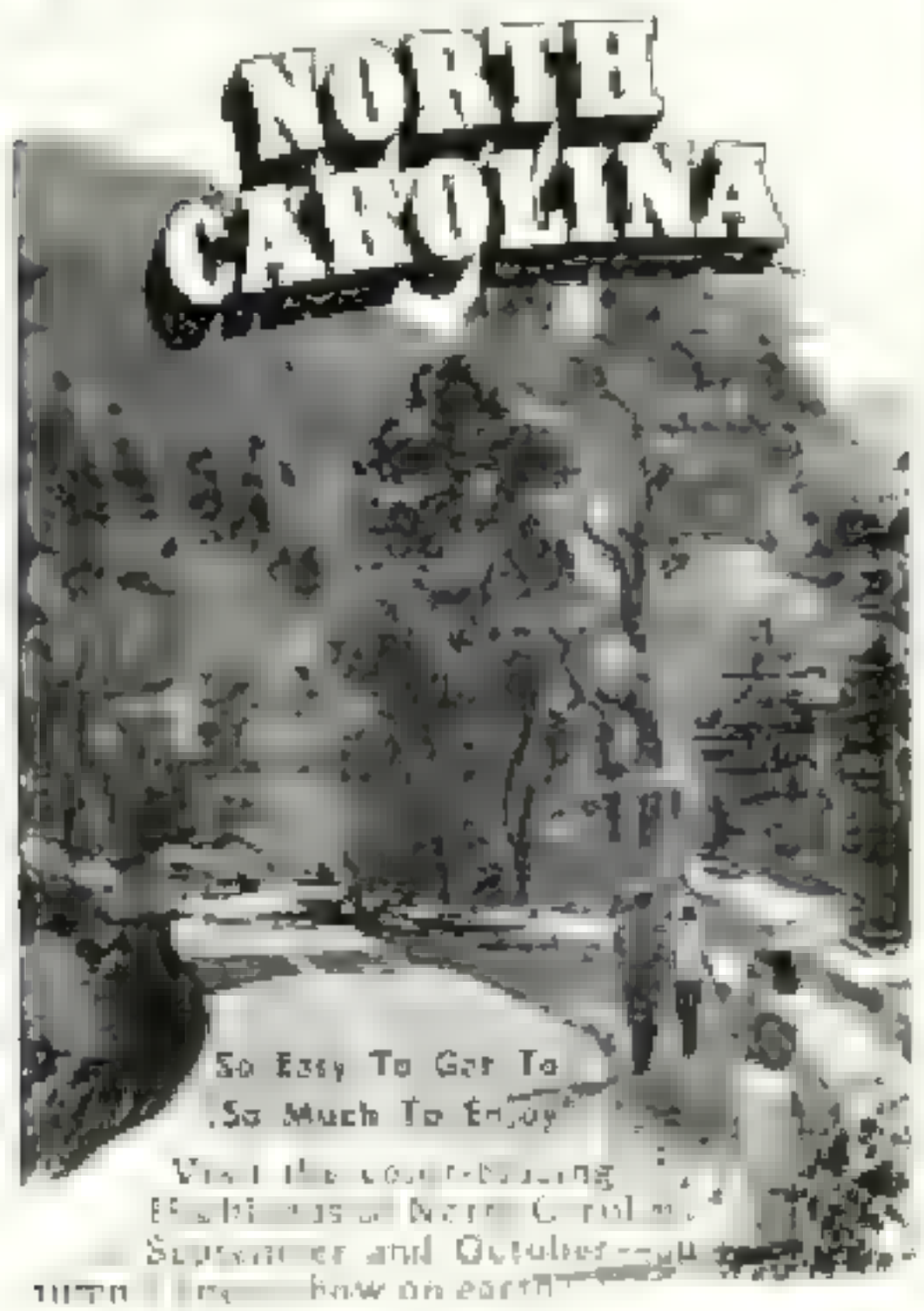
FROM MORNING TILL NIGHT the colors of the rainbow are all around you—through plastics. A blue plastic clock makes you sure I wou dispose on ivory plastic light switch. You [illegible] clothes from a yellow plastic hanger. Plastic toothbrushes come in colors for every member of the family. Cheerful decorating schemes are enhanced by the beauty of plastic drapes. There's no limit to the colors you can get in these versatile materials!

But this is only the start of the plastic story. Plastics make better clothing possible. Modern furniture and furnishings owe much to plastics. Much of your food is packaged in clean, clear plastics. Plastics add to the safety, durability and appearance of many of your electrical appliances.

These versatile basic materials are made. Organic chemicals are the ingredients of the "unfinished" plastics—called resins. From these resins come the many different forms of plastics we know.

The people of Union Carbide are leaders in the production of plastics, resins and related chemicals. They also provide hundreds of other materials for the use of science and industry.

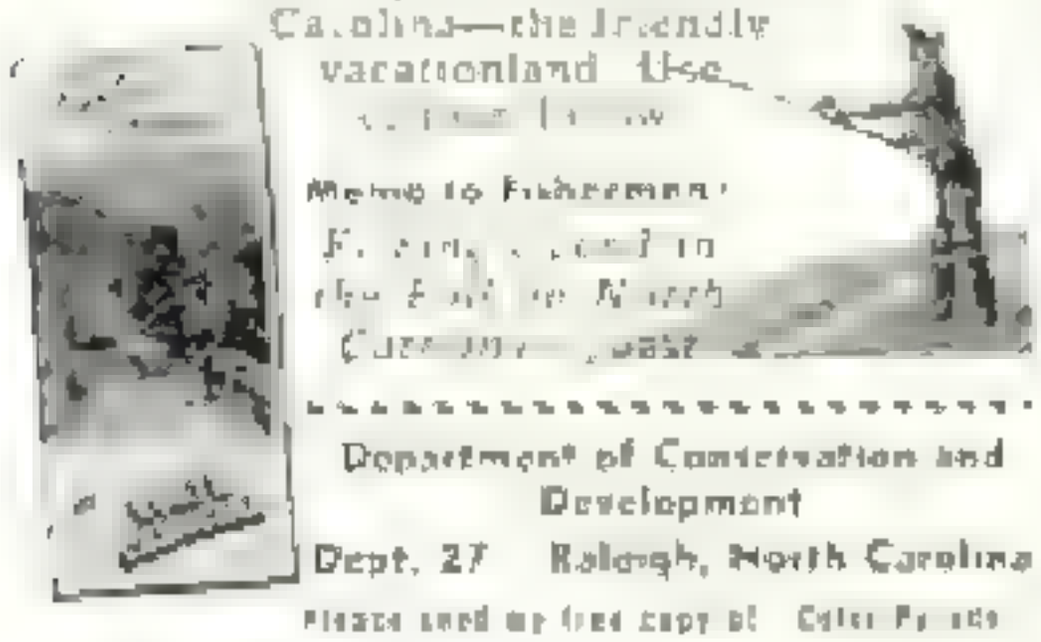
Color Parade . . . in Western



. . . in Western North Carolina—the friendly vacationland like no other! Visit the color-blazing Highlands of North Carolina September and October—a sight-seeing spectacular like no other on earth!

Speed to your favorite mountain retreat over the Blue Ridge Parkway, a scenic ribbon of Appalachian splendor. Fish and hunt in mountain streams filled with sparkling trout and in forests alive with game. Swing and [illegible] on championship golf courses. Enjoy the pleasure of relaxing resort living.

We've made it easy for you to explore "Color Parade" . . . your guide to the most spectacular in North Carolina—the friendly vacationland like no other!



Mail to Fishermen:
Fishing is good in the Fall in North Carolina's coastal waters

Department of Conservation and Development
Dept. 27 Raleigh, North Carolina

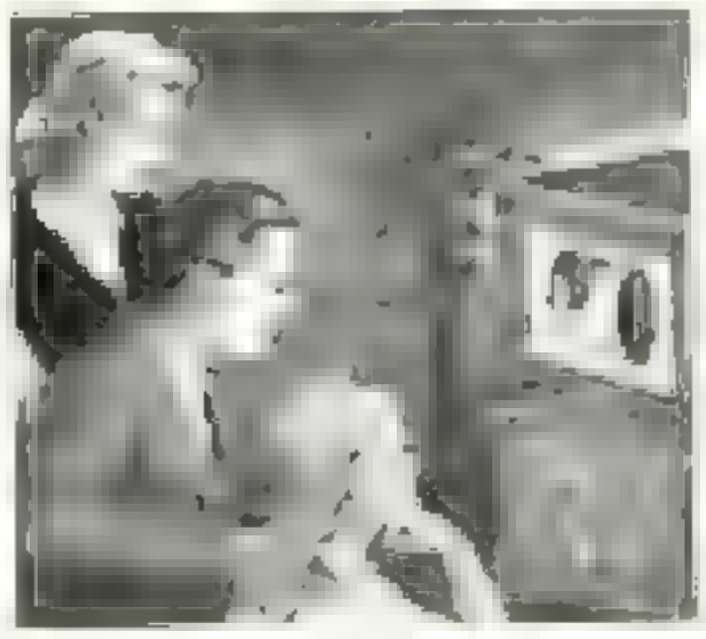
Please send me free copy of Color Parade

NAME _____

ADDRESS _____

CITY _____ ZONE _____ STATE _____

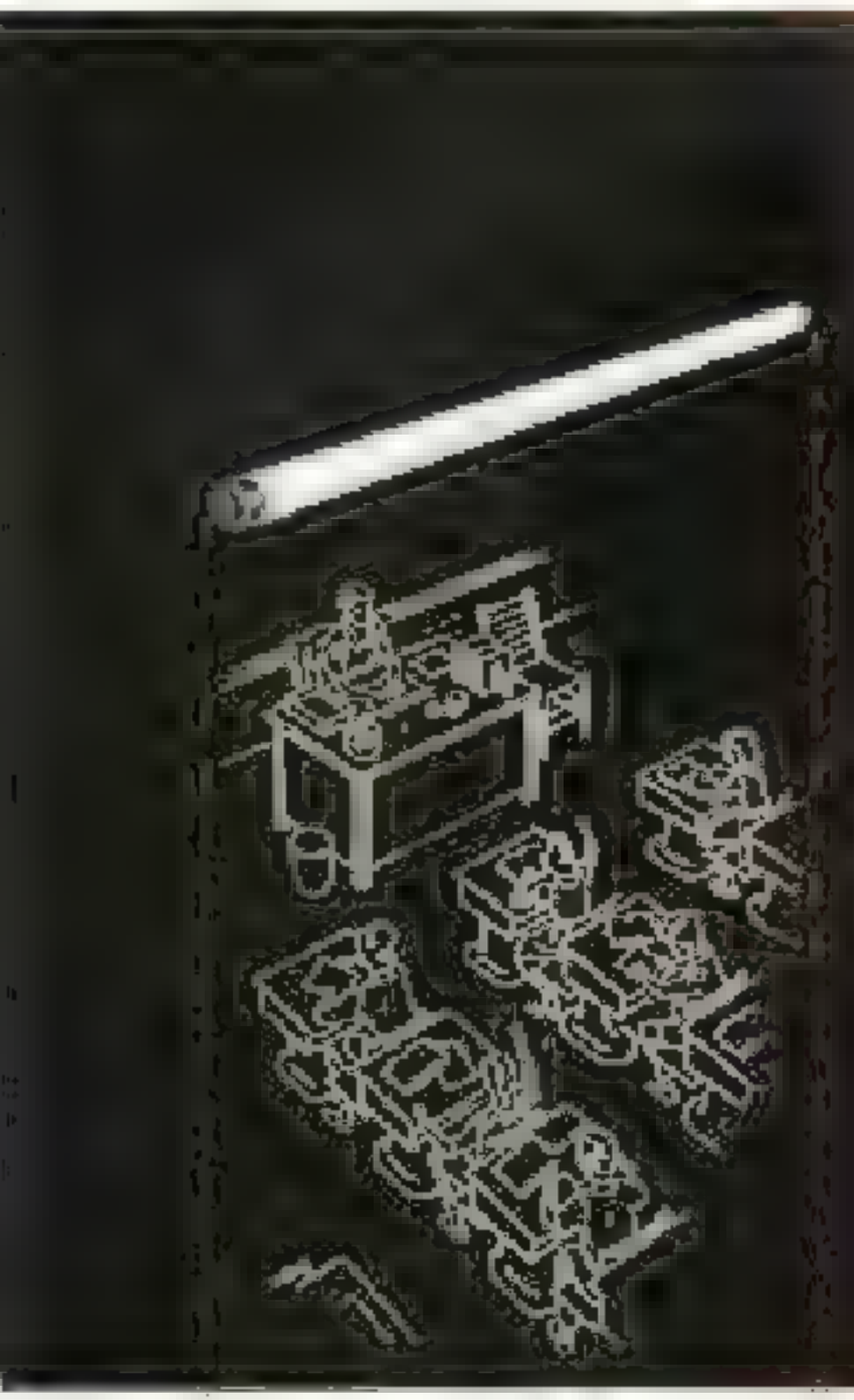
How to "see" a super fine slice of time!



RADIO CORPORATION of AMERICA

World Leader in Radio — First in Television

YOU CAN BE SURE..IF IT'S Westinghouse



ULTRA-VIOLET BY THE ROOMFUL

Best way to get your ultra-violet is out under the sun.

Next best way we want to tell you about.

Everybody needs ultra-violet for health. Everybody likes ultra-violet for sun. Most everybody gets too little, particularly with winter coming on.

Now it can be different, because our engineers have come up with a "wow" of an answer.

It's a new kind of sun lamp: Fluorescent. It's long; it's tubular; it bathes a wide area with cool, low-level but effective ultra-violet. It doesn't cost too much to buy and it is very inexpensive to operate because it doesn't waste electricity making heat.

Other important plus: Any office, display room, factories, *and* homes, where, if you wish, you can mount this lamp for high-speed tanning.

That's our commercial, except this: You can buy this tube of sunshine right over the counter. Or, you may obtain more information from our Lamp Division in Bloomfield, New Jersey.

. . . Also except this: It is one more example of the ingenious engineering inherent in our credo . . . You Can Be SURE . . . If It's Westinghouse

WESTINGHOUSE ELECTRIC CORPORATION • • • PITTSBURGH • PA.

GREYHOUND presents a great

Fall Round-Up of

TRAVEL BARGAINS!

This is the big travel event of [illegible] in every one of the 48 States and Canada. Greyhound has rounded up hundreds and hundreds of Fall trips, tours, and special features . . . expressly designed for [illegible] — are on color-brand values.

There are round-trip bargains [illegible] . Expense-Paid Tours [illegible] group trips to [illegible] Where you want to [illegible] Greyhound [illegible] at the Fun Re[illegible] of Travel Bargains.

BARGAINS

In ROUND-TRIP FARES

Everyone knows that Greyhound can [illegible] save money every mile [illegible] the extra big savings you enjoy on round trips by Greyhound! Here are some typical trips:

	One Way	Rd. Trip
NEW YORK—LOS [illegible]	[illegible]	[illegible]
[illegible]—JACKSONVILLE	18.85	33.95
[illegible]—SAN FRANCISCO	38.85	66.95
MINNEAPOLIS—SEATTLE	33.70	61.85
[illegible]—DENVER	17.10	31.00
[illegible]	[illegible]	[illegible]
DALLAS—NEW YORK	17.2[illegible]	31.05
[illegible]—NEW YORK	19.70	36.1[illegible]
PORTLAND—SAN [illegible]	11.55	2[illegible]
[illegible]—NEW ORLEANS	21.75	40.[illegible]
[illegible]—MIAMI	[illegible]	7[illegible]
[illegible]—WASHINGTON	[illegible]	2[illegible]
[illegible]—WASHINGTON	[illegible]	[illegible]

BARGAINS

In GROUP TRIPS to FALL EVENTS

They cost [illegible] Trips [illegible] or your Greyhound Charter Trips will keep your crowd together . . . take your group direct to hotel, [illegible] stadium, or anywhere you choose.

- TO BIG FOOTBALL GAMES
- TO STATE OR [illegible] FAIRS
- TO CONVENTIONS OR [illegible]
- TO FALL HARVEST [illegible]
- TO JAMBOREE PARKS
- TO THE WORLD SERIES
- TO BIG CITY FOR SIGHTSEEING
- TO [illegible]

See your local Greyhound agent about Charter Service for any club, church, school, band, or [illegible] organization. Do it today!

BARGAINS

In AMAZING AMERICA TOURS

[illegible]

GREYHOUND

FREE! "Amazing America" Tour Folder

Greyhound [illegible] 65 W. Madison, Chicago, [illegible]

NAME _____

ADDRESS _____

[illegible]

FOR TRAVEL FUN IN '51 . . . PLAN ONE OF

CANADA'S 10 TOP VACATIONS!

CANADIAN NATIONAL

the railway to Canada's 10 top vacations

New year (or mid-winter) issue of Canada's "10 Top Vacations!" Visit Jasper National Park (above) and interesting cities featured in the numerous pages of popular "Maple Leaf" Vacations. Lots, lots, more, plus the Canadian way! Send now for free booklets describing your choice of any of Canada's "10 Top Vacations" listed below. (U. S. Currency used on passports.)

CANADA'S 10 TOP "MAPLE LEAF" VACATIONS

1. Across Canada 2. Alaska Cruise 3. British Columbia ("Evergreen Province"). 4. [illegible] 5. [illegible] 6. Hudson Bay and Winnipeg 7. Jasper and Jasper National Park 8. Land of the Western Mounties 9. [illegible] 10. Ontario Highlights.

[illegible] the National Geographic — It [illegible]

"ROCKET"!

HYDRA-MATIC!

Oldsmobile has both!

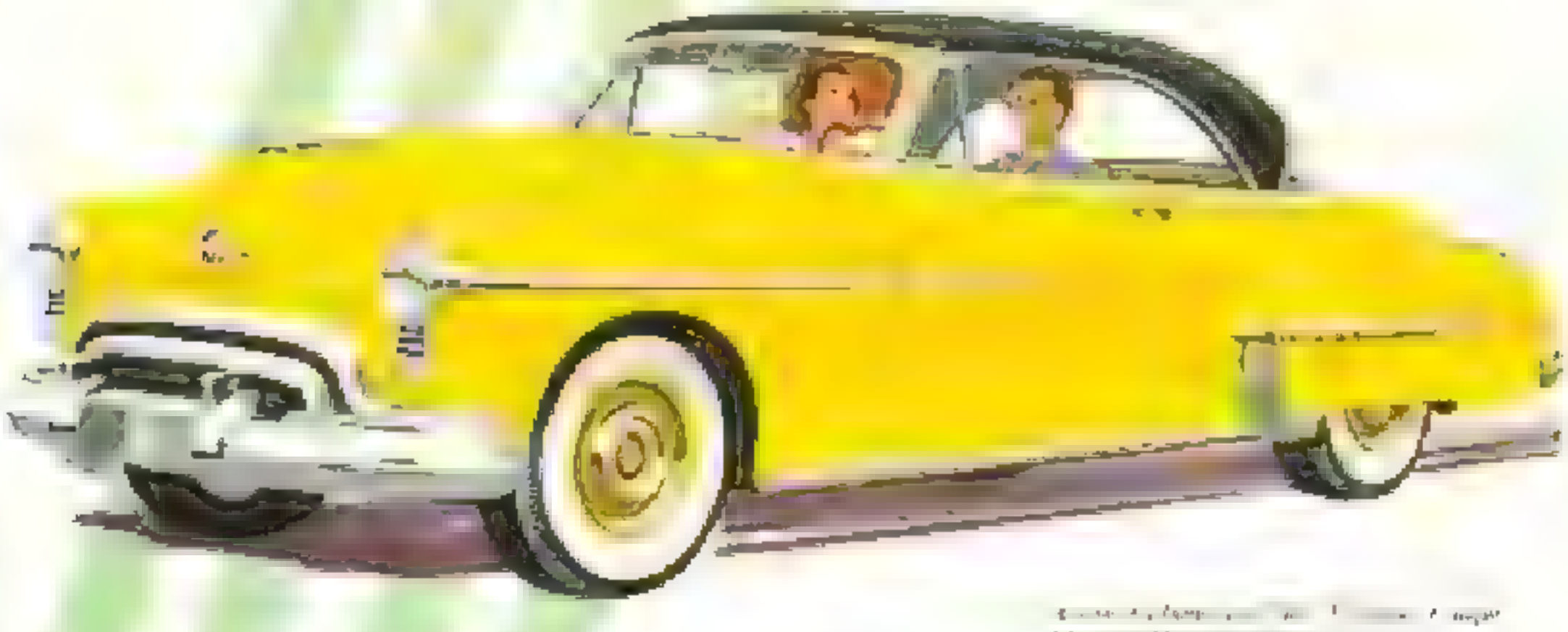
The famous high-compression

"Rocket" Engine—plus new

Oldsmobile Hydra-Matic Drive*!

Try this thrilling combination at your

nearest Oldsmobile dealer's!



OLDSMOBILE

Desert Sentinel... Leica color photograph by J. F. Orem, San Francisco, taken in Monument Valley, Arizona-Utah.

How to Clinch a Picture Classic

When man and nature set the stage for photographs of [illegible] interest, a Leica camera [illegible] to "realize" their fullest meaning. Light, compact ... easy to carry and maneuver ... easy to wind, to focus and shoot, it's hard to miss with a Leica. It's harder to match the outstanding *results* its famed precision and versatility assure in every kind of photography.

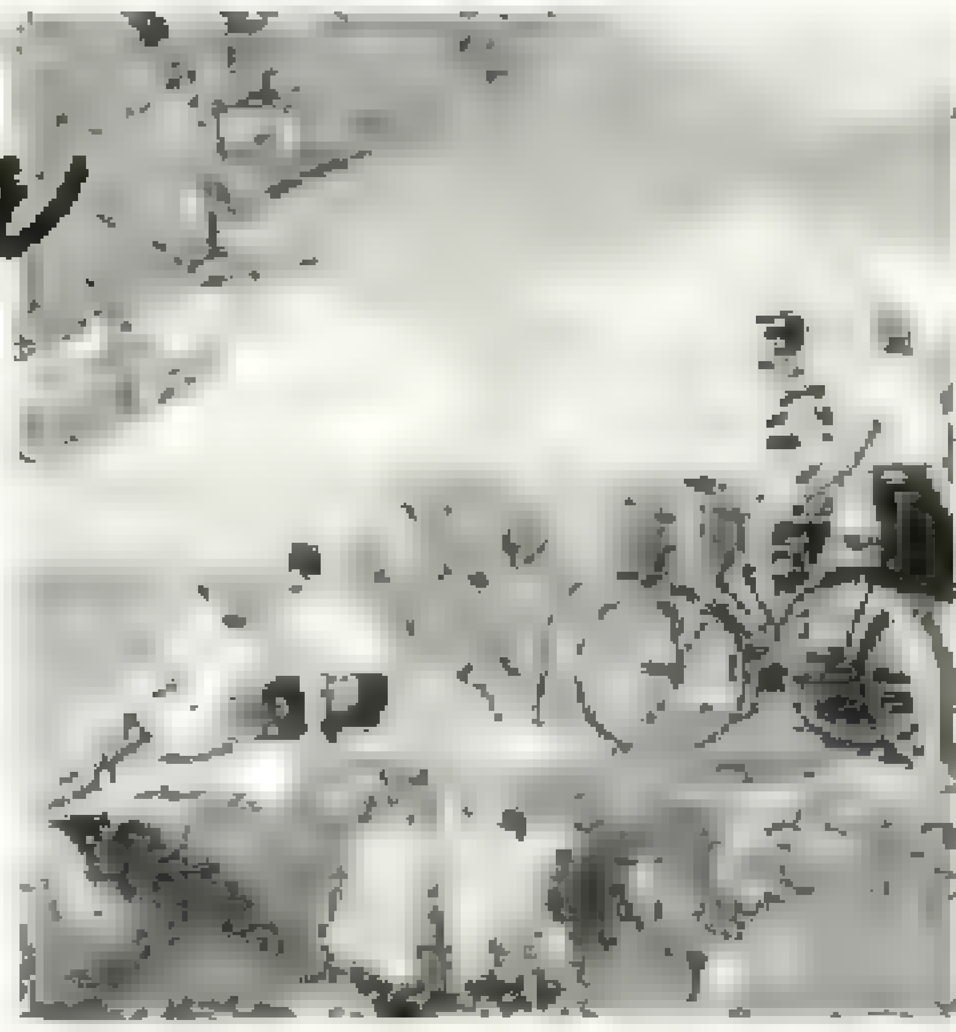
Take along a **Leica***

*Reg. U.S. Pat. Off. [illegible] trademark

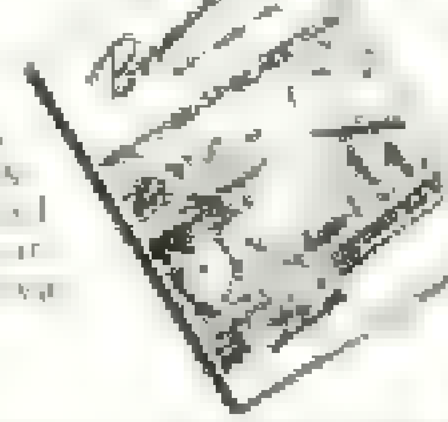
E. LEITZ, Inc., 304 Hudson St., New York 13, N.Y.

Bermuda

HOLIDAY...



Bermuda welcomes you to happy hours [illegible] on the softest pink sand... swimming in the blues, blue water [illegible] the [illegible]. For all that Bermuda is and means write for the new beautifully illustrated 16-page Bermuda booklet.



IT'S FUN [illegible]

[illegible]

Name

Address

[illegible]

I Wear False Teeth

yet my mouth feels fresh, clean and cool— thanks to Polident!*

"*Every day I soak my plates in a solution of Polident and water. My mouth feels clean and cool all the time . . . and no Denture Breath."

Mr. A. G. R., New Milford, Pa.

YOU know why, Mr. R— means—don't care! It's a wonderful feeling not to worry about offending friends with Denture Breath.

Soak your plates in Polident every day. It's easy and quick. And Polident reaches into every corner and crevice—places brushing never seems to reach.

Remember—those dental plates of yours need the special care of a special denture cleanser. Don't brush them. Soak them in Polident for only about a cent a day to keep them clean and free from Denture Breath. So get a can of Polident tomorrow, sure.

Soak plate or bridge daily—fifteen minutes or more—in a fresh cleansing solution of Polident and water.

No Brushing

POLIDENT

Recommended by more dentists than any other denture cleanser

Amazing New Cream Holds Tighter, Longer than anything you've ever tried or double your money back

POLI-GRIP

To Guard Your Health and Happiness

Since 1900, the life expectancy in our country has increased to nearly 67 years—a rise of about 18 years in less than half a century. This [illegible] by many advances in medical [illegible]

Today, the doctor has at his command new diagnostic techniques, improved equipment and greater knowledge of the factors affecting good health. There will undoubtedly be many other advances in the future. To get full benefit from these medical developments people have only to take one simple, easy step . . . see their doctors at periodic intervals.

Regular physical examinations do more than provide a check of your physical condition. They give the doctor an opportunity to advise you about your general health habits and daily routine. He may advise on the kinds and amount of food you should eat, or what to do to keep your weight normal, or the types of activities that are best suited to your physical condition and particularly to your heart.

In addition, the physician may be able to discover and correct conditions which might grow more serious if allowed to go untreated. To be sure you receive such a thorough check-up, your doctor may use such modern aids to diagnosis as these:

The X-ray. This is especially valuable in the search to discover diseases that often start without any outward warning signs. One of the X-ray studies enables the physician to detect [illegible] early, when chances for control or cure are best.

The fluoroscope. This permits the doctor actually to watch the functioning of the digestive system, the heart, lungs and other [illegible] When necessary by other tests, this offers additional help in diagnosis.

The electrocardiograph. This records the rate and rhythm of heart action. By revealing variations from a normal pattern, it gives the physician information about the functioning of the heart which is often not obtainable [illegible]

Blood tests. These offer valuable clues to general physical condition and help detect certain diseases. They may include sugar and chemical analysis of the blood, counts of red and white cells, and determination of hemoglobin content.

Please send me a copy of your booklet "[illegible]"

Name_____

Street_____

City_____ State_____

Why the robin hops . . . then STOPS

Sheaffer's alone provides a massive 14K gold point, pressed for your hand in 16 individual writing styles. Only Sheaffer's gold points give you such smooth, flowing, effortless writing!

Lifetime

Sheaffer's alone offers an exclusive lifetime-guaranteed, stylish Nylon Pen to any Fabric, Black or Plain. Hand waterproof against heat, dirt and rough use and gleaming beauty under damage and wear.

Exclusively Sheaffer's at Visible Ink refill indicator signals when fluid level is low. Your Sheaffer's pen never unnecessarily unexpectedly.

...A BETTER Pen

Sheaffer's gives you a better pen every inch of its length. Compare Sheaffer's with any other. Compare for beauty and balance . . . precision and performance . . . for sheer, clear, visible value. Compare, side by side, feature for feature and you'll never be satisfied with anything less than a genuine Sheaffer's!

No pillow ever muffs quite so quickly, so surely as Sheaffer's new Pentalever. Pentalevers lift completely with just one clever stroke!

Illustrated: Sentinel $15.00, no fed. inc. Others $3.75 up.

SHEAFFER'S

WHITE DOT ® OF DISTINCTION

America's FIRST Choice

® w. a. sheaffer pen co. fort madison, iowa, u. s. a.
in canada: new glasgow, n. s.

With Kodachrome Film in your miniature camera you get this

Double Reward

1. brilliant screen projection of your Kodachrome pictures . . . finished as color slides without extra charge

2. gorgeous Kodachrome Prints made to order . . in the reasonably priced 2X size shown, or in larger sizes

Amateurs suddenly feel like experts when they [illegible] what wonderful *color* pictures they [illegible] take with Kodachrome [illegible] camera [illegible] with f/6.3 lens or better. Add [illegible] these superb pictures are so easy to take!

Fine equipment for less money . . .

And now Kodak has produced an ultraeconomical [illegible] camera with f/4.5 Lumenized [illegible] at the remarkably low price of $[illegible] including Federal Tax. Ask your dealer [illegible] Kodak Pony 828 Camera. With it—and Kodaslide Projector, Model 1A, at $29.[illegible] you're well equipped to start your Kodachrome career. Also see Kodaslide Table Viewer—projector, screen, and slide changer combined . . . [illegible] Master Model illustrated).

Eastman Kodak Company, Rochester 4, N. Y.

It's Kodak for Color

Kodak

Indian Summer in Pennsylvania

[illegible]

[illegible]

[illegible]

YOU'LL FIND MORE IN

Pennsylvania

JAMES H. DUFF
Governor

PENNSYLVANIA DEPARTMENT OF COMMERCE
SUITE 208 HARRISBURG PA

[illegible]

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Address _____

_____ State _____

Judd & Detweiler, Inc.

[illegible]

Printers

[illegible]

Economy is a cheerful note in train travel. It is even more pleasing when combined with the comfort and enjoyment that are yours in restful Coaches on Union Pacific's daily

"CITY OF LOS ANGELES"

"CITY OF SAN FRANCISCO" "CITY OF PORTLAND"

Daily between Chicago-the West Coast

"CITY OF DENVER" .. Daily between Chicago-Denver

"CITY OF ST. LOUIS" .. Daily between St. Louis-the West Coast

PULLMANS AND RESERVED SEAT COACHES ON ALL STREAMLINERS

Write Union Pacific Railroad Room 383, Omaha 2, Nebraska
for free California Pacific Northwest and Colorado booklets

UNION PACIFIC RAILROAD

Dependable Passenger and Freight Transportation

Recommendation for Membership

IN THE

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"The Membership Dues, Which Are for the Calendar Year, Include Subscription to the National Geographic Magazine"

To the Secretary, National Geographic Society,
Sixteenth and M Streets Northwest, Washington 6, D. C.: _____ *1950*

I nominate _____

Occupation _____

Address _____

for membership in The Society.

Name of nominating member _____

Address _____

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Kindergarten through 9th Grade

Calvert "School-at-Home" Courses give your child the same study plan used in the famous 50-year-old Calvert Day School in Baltimore, with guidance by the same teaching staff. Used by 85,000 children. Daily lessons, books, supplies sent by mail anywhere in the world. Calvert students transfer to other schools easily, often with advanced standing. Unique new Crafts Course. Start any time. Write for catalog. Give age of child and school grade.

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Dept. 60-P
Radio City, N. Y. 20, N. Y.

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DEAN ACADEMY & JR. COLLEGE
COED—2 & 4 YR. COURSES

LIBERAL ARTS for college prep. or transfer. Music, speech, drama. **BUSINESS ADMIN.**, special business training plus liberal arts background. Sec'l prep for secretary, med'l, medical sec'l. **HOME ECONOMICS:** Unusually complete program. Includes home management house, body management, foods budget, clothing, interior study. **ART**, fashion, interior decorating, advertising and merchandising. SMALL CLASSES, complete guidance and placement service. Assoc. degree. Beautiful campus and traditions. All sports, pool, moderate rates. Catalog. **W. L. Garner, Pres., Franklin, Massachusetts.**

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MATURE STUDENTS complete 2 yrs. high school in 1 yr. Simplified instruction. Earn State-Accredited Diploma. 13,000 grads in leading Colleges. Supervised dorms. Founded 1912. Vet. Approved. Catalog. **Dept. N-9, 203-17 S. 20th St., Phila. 3, Pa.**

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EDGEWOOD PARK

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For 175 years a school for girls, in the southern manner. Prep. H. S. 2 yrs. Standard College work. Art, Music, Dramatic Art, Secretarial. Modern fireproof student residence hall. Address: **French W. Thompson, Pres., Box N-60, Lewisburg, West Virginia.**

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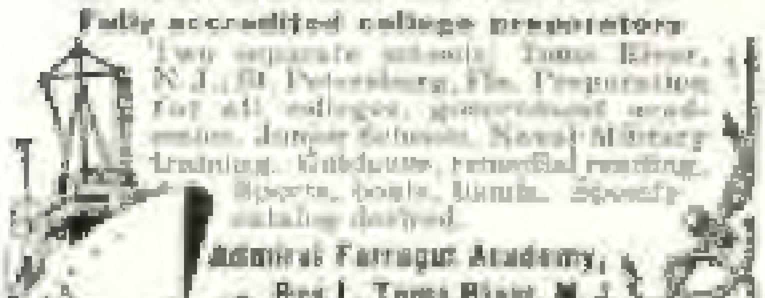

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